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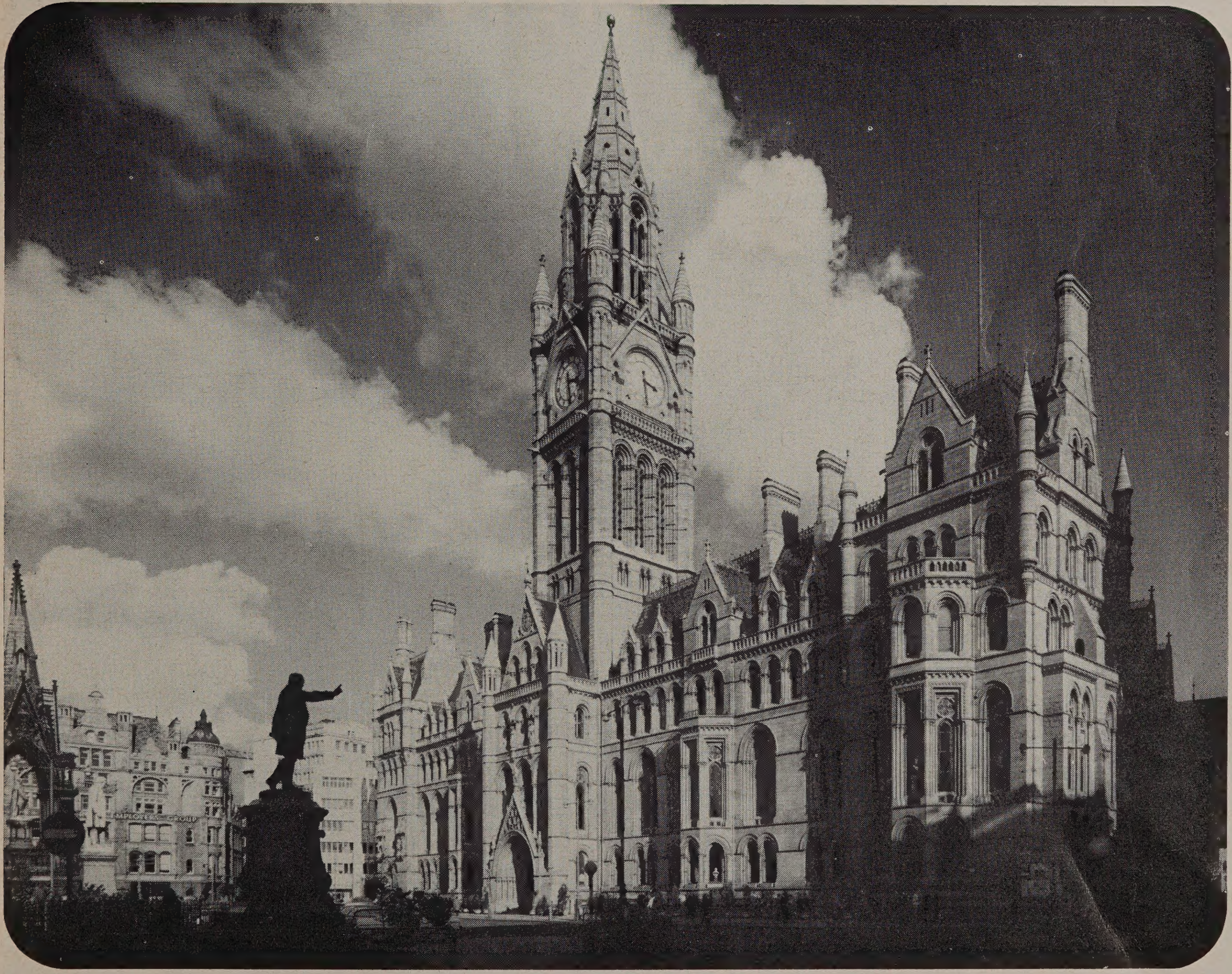

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CLEAN AIR

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Smokeless Air in 1976

It is common practice in the New Year to review the previous twelve months particularly from the standpoint of any special interest, which for us, is the environment and clean air. Some will remember 1976 for its long, hot, dry summer followed by the wettest autumn for 250 years; others for the economic climate resulting in public spending cuts and a loan from the IMF. Each of these in their own way have had effects on the environment and clean air.

It is often said that because of the climate in this country we do not need the draconian type of legislation to control pollution from motor vehicles. But during the long hot summer days there was sometimes more than a hint of photochemical smog in some of our major cities, and this would seem to indicate that more control than we now have is called for.

Economic consideration caused slow progress in smoke control. 1975 was a poor year, but in 1976 the number of smoke control orders brought into operation was 12% less than in 1975. Unfortunately, worse was to follow on 22nd December 1976 when the Government issued Circular 123/76 on cuts in public expenditure, for this imposed a moratorium for six months from 15th December on all expenditure on smoke control. So, after a lean year the outlook for 1977 does not look very bright. Inevitably smoke control along with ' other environmental services ' should take its fair share of any cuts. But it is depressing nonetheless. It is hoped that local authorities will continue to plan for new smoke control areas when expenditure is once more permitted. No doubt many of them will do so but, unfortunately, others may tend to read this Circular as yet another mandate for stopping smoke control altogether. Perhaps more important is that in some parts of the country the general public believe that because of the falling off in smoke control, it no longer matters, and even that the use of bituminous coal in smoke control areas is no longer an offence.

So the Society's task for the months ahead is quite clear: efforts must continue to ensure that the public is properly informed about the necessity for clean air and the benefits which it brings. They must understand that only smokeless fuels can be used in smoke control areas. As regards the suspension of the control programme we must impress on all concerned that this must not be allowed to be any more than a temporary setback.

However, we still have a foundation on which to build. Following the publication of the Fifth Report of the Royal Commission on Environmental Pollution 'Air Pollution Control: An Integrated Approach ', the Government issued Consultation Papers about the Royal Commission's proposals. These achieved a welcome response, and the various views put forward are now being considered and weighed. What the outcome will be is not yet known; but what is clear is that there is still a large body of opinion which believes in clean air.

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Smokeless Zones—
The History of Their Development

by

C. V. Malcolm, M.Sc.

Part 2— The Development of Smokeless Zones 1934-1958

On 31st October 1934 the Manchester City Council adopted the following resolution:

"That the General and Parliamentary Committee be requested to consider and report upon the desirability and practicability of making available to the public smokeless fuels, including gas and electricity, at such cost (not including a charge upon the rates) in relation to raw coal as will permit their use in preference to coal, and thus make a definite contribution to a cleaner atmosphere."

There is no indication in the records of how this motion arose but it is recorded that 'not' was included instead of 'if necessary' relating to a charge on the rates, as a result of an amendment. The move appears to be an attempt to do at local government level what the Interim Report of the Newton Committee had failed to do at national level fourteen years earlier, to tackle the domestic smoke problem. Fortunately it met with greater success. The Report of the General and Parliamentary Committee[1] recommended that:

1. The Housing Committee be instructed as an experiment to provide, in 50 Corporation houses, coke grates, and arrange for Manchester Corporation Gas Department coke to be supplied for one year and a report made to Council.
2. The Town Hall Committee should experiment with various fuels in suitable Town Hall offices and report in one year.
3. The Gas Committee should report on the installation of a plant to produce low-temperature carbonisation fuel and report.

An appeal was also made for the public to experiment with smokeless fuel. The report was adopted. Council had therefore recognised by now that there was more to domestic smoke control than the suppression of nuisances and the ground was prepared for a simple, but novel, and in a sense revolutionary suggestion.

In 1934 Charles Gandy, a Manchester barrister, became chairman of the National Smoke Abatement Society which had its headquarters in Manchester and he held the post until his death in 1950[2]. Gandy made the outstanding contribution in 1935 of suggesting the concept of "the smokeless zone". The Society adopted his suggestion and pressed the City Council to bring in smokeless zones. A large central area was surveyed in the central city as a potential smokeless zone in 1938[3]. In May 1939 the Public Health Committee received a deputation from the National Smoke Abatement Society[4]. Members of the deputation addressed the Committee "in support of a proposal that statutory authority should be obtained by the Corporation for the establishment of an area comprising the central commercial district of the city in which the mere emission of smoke from premises, other than those occupied as private houses, would be a smoke nuisance for the purposes of the Public Health Act 1936". The proposed "smokeless central area" of about 104 acres was designated. The Committee instructed the Medical Officer of Health to survey all premises in the area and a detailed report was made to Council in December 1939. The report stated that business premises in the area used gas and electricity to a considerable extent and that over half the solid fuel consumed was smokeless. It was concluded that it appeared to be "a practicable and economic proposition for those commercial concerns which continue to pollute the atmosphere by smoke, to follow the example of their more enlightened neighbours".

Before smokeless zones were suggested, domestic smoke abatement had tended to reach a stalemate. The Newton Committee's report had inferred that until the Government would act on domestic smoke it should 'get off the back' of industry. Government, on the other hand, was not prepared to legislate to control the beloved open domestic fire. Smokeless zones were the thin end of the wedge. Commercial areas and new housing estates could be made smokeless at minimum cost either in terms of money or votes, and it took a legal mind to devise this new abatement method. Moreover the zones could be expanded as opportunity arose.

Lawson (pers. com.) states that by careful design and operation of heating systems it was possible actually to economise on heating by going smokeless. This was the sugar on the smokeless zone pill. Gas pokers made little difference to the overall smoke situation but avoided the unsightly lighting up period when paper, wood, etc. were normally used. The gas pokers were in effect a cosmetic addition rather than an essential feature and were excluded in some other cities (Lawson pers. com.).

It is interesting that the initial smokeless zone suggestion specifically excluded domestic premises. Ashby[5] has noted the reluctance of Londoners to surrender their open fires and quotes the Chief Officer of the London County Council in 1904 "The open fire is such an essential feature of our national homelife that any attempt to abolish it is almost out of the question[6], an opinion originally expressed in 1845.

In the 1930s, the Council made a practice of providing a set financial "ration" for its various Departments. The only justification accepted for an excess in expenditure was added costs due to new legislation imposed by Parliament or unforeseen or unavoidable circumstances. These restrictions continued into the war period and would have rendered impossible any suggestion that the Council should assist householders with

the conversion of fireplaces unless it came from a change in national policy[1]. In the absence of a change in national policy, the Council did the next best thing. Following the adoption of the report of the General and Parliamentary Committee in 1934, it was agreed to put experimental coke-burning grates in a Corporation housing area[1]. The suggested smokeless zone was promptly investigated in 1939 and had it not been for the war it would probably have been implemented earlier than its eventual operation date, 1952.

In fact the Council included the smokeless zone powers in a local Act for the Haweswater water supply scheme in 1938-39 but it lapsed due to the war (J. Lawson pers. com.). The inclusion of smokeless zone powers was assisted by the efforts of Councillor Will Melland (J. Lawson pers. com.).

During 1939 the Council's special sub-committee on Smokeless Fuels (including gas and electricity) was re-appointed[4]. The report of the Public Health Department made mention of the valuable contribution to smoke abatement made by the Gas and Electricity Departments. Details were given of the numbers of premises served.

The difficulties encountered at this time are illustrated by the fact that the drafting of a constitution for the South East Lancashire Joint Smoke Abatement Board was delayed by precedence being given to Air Raid Precautions and Civil Defence work at the request of the Government[7].

The National Smoke Abatement Society was still active, and having made its suggestion on smokeless zones to the Council in May, in July Mr Gandy addressed the full Committee of the Manchester & District Regional Smoke Abatement Committee. An abridged account of his address was printed in the Committee's Annual Report[4].

The NSAS was also active at the national level and in 1942 submitted a memorandum to the Ministry of Works and Planning and the Ministry of Health concerning smoke prevention in initial postwar reconstruction, another bite at the Newton Interim Report cherry. The same suggestions were made by the NSAS to the Manchester Council. The Health Committee adopted a resolution agreeing to recommend support for the Society's proposals. The proposals and resolution were forwarded to the Housing and Town Planning and Building Committees.

The Manchester City Council was preparing in the early 40s for a local Act to obtain a variety of powers. The Public Health Committee requested:

"(a) Power to prescribe areas or zones in the City in which the emission of smoke of any colour or density shall be prohibited."

"(b) Power to prohibit the installation in houses of domestic appliances which cannot be used without producing smoke[8]."

The Town Clerk prepared a report on the various powers sought by all Committees and included powers necessary to put in a district heating scheme at Wythenshawe. The Public Health Commitee noted that although the Public Health Act 1936 contained provisions for dealing with industrial smoke, domestic smoke was not covered. Moreover Section 104, which allowed the local authority to make building by-laws to require in new buildings heating or cooking arrangements calculated to reduce or prevent the emission of smoke, did not apply to private houses. The Committee stated that it was generally agreed at least 50% of smoke came from domestic chimneys.

The General Purposes Committee reported to Council on the preparations for the "Promotion of a Bill in Parliament" and noted that the General and Parliamentary Committee had recommended against the second power requested by the Public Health Committee. Council approved the report late in 1945[8]. The Manchester Council had therefore hesitated at exactly the same point as the Central Government, probably owing to the shortages of fuel and appliances which caused delay in the application of the smokeless zone powers.

As an alternative to controlling smoke from domestic grates, the use of district heating schemes is attractive. However, in discussions between a deputation from Council Committees with officers of Government Departments, the officers of the Ministry of Health explained that the Government would need much fuller information before agreeing to bear any finance for district heating. A joint working party was formed[9] and recommended[11] that Council approve the principle of district heating and have a detailed plan prepared. However, the Finance Committee suggested that since the scheme would result in elimination of smoke and conservation of fuel, it had elements of national significance which should be suggested for Government support, especially owing to the risks and liabilities and the pioneer work involved.

Once Council had approved the form of the Manchester Corporation Bill, the General and Parliamentary Committee on 5th December 1945 recommended a meeting of local Government Electors to be held to approve or otherwise the promotion of the Bill[9]. At the meeting the Chairman agreed to put certain clauses, including that dealing with the prohibition of smoke in certain areas, separately, and it was passed. A clause prohibiting the installation of industrial furnaces unless they could be operated smokelessly was also approved[9].

Local Act Bills are normally considered by select committees of the Houses of Lords and Commons. Reports are received from Government Departments and considered together with any petitions. A Council Sub-committee was appointed to handle queries on the Bill. Under the Sub-committee's direction, and in consultation with the Corporation's Parliamentary Agents (Sharpe, Pritchard & Co) negotiations were entered into with the petitioners and discussions took place with Government Departments[9]. Petitions were received from Cheshire Lines Committee, London, Midland and Scottish Railways Co, London and north Eastern Railways Co, ICI Ltd, Owners and Occupiers of Works and Premises in the City of Manchester (36 firms) and Cinematograph Exhibitor's Association of Great Britain against Clause 34 (Prohibition of Smoke in Certain Areas) and from the last three petitioners against Clause 35 (Prevention of Smoke from Industrial Furnaces). Both Clauses remained in the Act but with some amendments as explained in the following extract[9]:

> "Clause 34 (Prohibition of smoke in certain areas) sought to prescribe a smokeless zone in the centre of the City and also to enable the Corporation to prescribe further zones from time to time. Only one Petitioner objected to the smokeless zone in the centre of Manchester and the objection was subsequently withdrawn, but the Minister of

Health suggested that the time when emission of smoke should be prohibited in that area should be approved by him. As an alternative to this suggestion the Corporation proposed that the Minister should be consulted before the provisions relative to the central area were brought into effect and a provision on these lines was inserted in the Bill.

The Minister of Health and the Lord Chairman of Committee in the House of Lords suggested that an extension of the smokeless zone to parts of the City other than the central area should be subject to an order made by the Corporation and submitted to the Minister for confirmation and that persons affected should be given an opportunity of objecting and having their objections heard, if necessary by one of the Minister's inspectors at a local inquiry. This suggestion was accepted and provision was made in the Bill accordingly.

Further, the exemptions which the smoke abatement legislation in the Public Health Act 1936, makes in relation to certain industrial processes (such as mining, etc.) have been incorporated in the Bill, subject, however, to the qualification that, before any such exemption is given, the Minister of Health must be satisfied that the inclusion in a smokeless zone of any premises in which those processes are carried out would obstruct or interfere with those processes.

Clause 35 (prevention of smoke from industrial furnaces) sought power to ensure that a furnace for steam raising or for manufacturing or trading purposes should not be installed in a building unless the furnace was capable of being operated without causing a nuisance. Upon further consideration this clause was extended so as to provide that before installing a furnace a person may submit particulars of his proposals to the Corporation, and unless the Corporation indicate that they are not satisfied with the furnace no proceedings shall be taken against the person installing the furnace."

The administrative procedures agreed upon in these discussions were later to be used for smoke control areas.

Because much of the groundwork for the smokeless zone idea had been laid before the war, the Council was able to act quickly to obtain powers after the war was over. The provisions of Clause 35 were described by the Chief Sanitary Inspector as "rather revolutionary"[3]. The war itself was a mixed blessing even as far as smoke abatement was concerned. The Civil Defence Act 1935 called for a reduction in glare from burning spoil heaps and resulted in a reduction in smoke and noxious gases[10]. However, in 1940 an order was made requesting smoke production, a request which was at odds with a 1942 Government order calling for fuel economy[7].

The post-war period involved serious shortages of fuel, including smokeless types, and difficulty in converting grates to gas, electricity or other smokeless fuel. The additional load a smokeless zone would have placed on supply undertakings during this critical period was also considered. The Health Committee (note the name change from Public Health Committee) therefore decided to delay premature action on smokeless zones to avoid prejudicing ultimate success by taxing the goodwill and co-operation on which the scheme depended. Action was deferred until production and availability of fuels and appliances was more favourable[11].

Despite the war, the Investigation of Atmospheric Pollution continued. Since its commencement in 1915 the Investigation had obtained continuous data for deposit gauges at many sites. In Manchester the programme was suspended from 1930 to 1935. The work was co-ordinated by the DSIR and the Standing Conference of Co-operating Bodies met twice a year to share information and hear papers. In 1936 it was reported that there had been a marked reduction in the extent of pollution of the atmosphere in Britain during the previous 20 years[12]. A detailed survey of air pollution in Leicester[13] was begun under the auspices of the Standing Conference and continued despite the war because of its importance[10]. It included a study of the effect of a park as a theoretical "smokeless zone".

In July 1946 the North West Divisional Council of the National Smoke Abatement Society was re-formed with a new constitution following a quiescent period during the war[14]. Mr Gandy was at this time Chairman of the National Executive Council of the Society, to which the Divisional Council sent resolutions either for the Annual Conference or for representations to various ministries. The Council met quarterly usually in local authority premises with refreshments provided and organised joint meetings with, in particular, the Institute of Fuel, as well as organising occasional public meetings and exhibitions. The normal membership of the Society figured little in the activity of the Council which aimed its programme intentionally at the well-informed and influential members of the public. This policy could have stemmed from the high powered personnel on the Council. Thus in 1949 the Council consisted of the four office bearers, plus 16 members all from different local authorities, plus six representatives to the National Executive Council and nine co-opted members representing various organisations. A total of eleven were elected members of local authorities and several Medical Officers of Health were on the Council.

By 1955 the number of co-opted members on the Council had risen to 17 and it included representatives of 10 fuel interests and eight non-fuel interests. Government departments and instrumentalities, consumer groups, professional societies and industry were covered but there was no coverage of town planning, architecture, the environment, legal and administration skills or the arts in general.

In effect, the Council and the Society as a whole acted as a clearing house and sounding board for the ideas of persons engaged in some way in smoke abatement. It was tantamount to a professional organisation and valued its standing in the community highly. The Council tended to avoid public campaigns despite sentiments expressed on the Council that meetings arranged for talks to the converted were not progressive. When the Sanitary Sub-committee of the Manchester Health Committee approached the Council in 1951, suggesting what amounted to mounting a publicity campaign, they replied that it was "entirely beyond the resources of the Society"[14].

The general policy of the Society and Council was to make representations to various ministries on:

(a) Fuel supplies and distribution;

(b) Installation of smokeless appliances in municipal housing schemes;

(c) Reduction of the cost of smokeless fuels and electricity;

(d) District heating schemes and smokeless zones.

Most speakers at Society meetings discussed problems, procedures and equipment related to the above topics. Consequently, when in 1947 the Simon Committee reported on a Domestic Fuel Policy[15] which was "fully in accord with the objectives of the Society", the Honorary Secretary of the N.W. Divisional Council (Mr H. Moore, Chief Clerk of the Manchester Health Department) reported "Surely this represents the greatest forward step the Society has made in its history"[14].

The Society urged the Government in 1946 to use the fuel crisis as a spur to combine fuel economy and smoke abatement and to give it a high priority in national policy. However, fuel supply problems plagued the smoke abaters. Repeated approaches were made to the Ministry of Fuel and Power in the late 40s, to improve fuel supply and distribution and to publicise the Ministry's newly developed solid smokeless fuel domestic appliances. The Fuel and Power Ministry appears to have been as effective a smoke abatement force at this stage as the Health Ministry. Following the Domestic Fuel Policy Report, an Interdepartmental Committee produced a list of approved appliances and exhibition and information centres were established to demonstrate their use. In 1948 the Fuel Efficiency Committee was reconstituted with regional sub-committees and by 1954 a National Industrial Fuel Efficiency Service (NIFES) was available to advise local authorities and others. The Fuel and Power and Health Ministries were first represented on the N.W. Divisional Council of NSAS in 1950 and in 1955 a NIFES representative replaced the former[14].

The NSAS recognised that, owing to fuel and appliance shortages, progress must be on a limited front and the N.W. Divisional Council sent resolutions to the 1948 Annual Conference pressing for Government financed housing to be made smokeless and for the sale of non-smokeless solid fuel appliances to be prohibited as soon as possible (Recommendation 2c of the Simon Report). Reporting on the Conference, Moore stated[14] "The fact that Pittsburg has introduced an ordinance to forbid the use of bituminous coal both domestically and industrially (except for mechanically-fired furnaces) gives rise to thought that the day may arrive in this country when the "peaceful persuasion" advocated by fervent democrats, may be abandoned in favour of more direct methods to achieve improved living conditions for the community at large".

The N.W. Division's resolutions were carried at the 1948 Conference but "an amendment to make the second resolution even more forthright and progressive was only narrowly defeated after Sir Ernest Smith had counselled prudence". Moore hoped other Divisions would follow the North West's lead in showing it had the courage to say what it believed.

The Ministry of Fuel and Power ruled out prohibition of manufacture and sale of non-smokeless grates because of the major testing scheme which would be required. The Ministry of Health asked local authorities to provide only for improved appliances, the production of which had greatly increased, in their housing schemes. The question of how to get private builders to do the same was under consideration[14].

In 1949 the Society tackled the problem of replacing old grates. The Simon Report had recommended (2j) a Government subsidy to encourage the replacement of old grates. The N.W. Divisional Council decided that a more limited resolution, that the installation of approved appliances should be a condition of qualification for an "improvement grant" under the Housing Bill at that time before Parliament would be more favourably received. Actually the Ministry forestalled the Society by including the points in a Housing Act circular in 1949.

Smoke abatement was not a major public issue at this time. In 1949 at its Harrogate Annual Conference the NSAS received a report of its own National Survey of Source and Incidence of Atmospheric Pollution. The position had in general deteriorated since 1939 and considerable ignorance and apathy by many local authorities and the public was revealed[14].

Reporting on the Survey, Moore stated:
"To educate these authorities and the lukewarm mass of the general public entails a very long-term policy of snail-like progress. Few reforms have come about by waiting for public opinion to express its approval; indeed, many benefits enjoyed by mankind today have been brought about in spite of adverse public opinion and opposition.

The Society could be more militant in its policy, and even though the present time may not be favourable for action on these lines, preparation could proceed so as to be ready immediately the situation is ripe for the positive action."

Perhaps at the other extreme within the Society was the retiring president who told the Harrogate Conference that the smoke nuisance may be got rid of in 20-30 years, a forecast that may be surprisingly accurate.

At the suggestion of Charles Gandy the Society held an exhibition in Manchester late in 1950. Unfortunately, he died earlier in the year. At the national level the Ridley Committee was set up in 1951 to recommend on a National Fuel Policy[16]. It recommended the development of low carbonised fuel (semi-coke) which would burn in almost any type of grate[17]. The cost was high in 1953 but it was hoped increased production would lower the price. The nationalisation of the coal industry in the forties had enabled more emphasis to be placed on smokeless fuel production[17].

The Manchester City Council Health Department had also been making slow smoke abatement progress over this period. Thirty-seven vacancies in inspectorial staff in 1948 resulted in the curtailment of their duties with nuisance inspection being amongst those neglected[18]. To rectify the position, the Health Committee proposed improved salary scales justified in part by the extra technical advice to be given following the smoke abatement clauses of the 1946 Manchester Corporation Act. The Establishment Committee disagreed with the Health Committee's case but it was approved by the Council[18].

When fuel supplies improved, somewhat tentative arrangements were made for a detailed survey of the central city area in 1949 as a preliminary step towards making it smokeless[19]. After the survey, and consultations with the Ministry of Health, the City Council resolved that the date of operation of the central smokeless area would be 1st May 1952[20]. The area was the original 104 acres proposed by the NSAS and comprised mainly offices, administrative premises, commercial

buildings, shops and department stores. It was acknowledged that it was small but it was hoped it would demonstrate to a large daily population the practicability of a large built-up area becoming smokeless by progressive extension[20]. A great deal of emphasis was laid on the importance of ensuring the goodwill and co-operation of the public for the smokeless zone which was regarded as a 'radical' move[21]. Lawson, Chief Sanitary Inspector 1946-53 during the implementation of the first smokeless zone, states (pers. com.):

"The powers (smokeless zone) were premature in 1946 because Raven grates were not available and neither was fuel. Technical advice was given to owners and *most of all* judicious timing of the operation (was ensured) to obviate prejudice from premature action." Lawson (pers. com.) admits to his concern after the war at applying new regulations to a public which, he believed, may be tired of regulations. The readiness with which the new innovation was accepted was a pleasant surprise.

Following the advertising of the operation date many requests for advice and information were dealt with. There were also queries from owners of premises in adjacent areas concerning long-term planning[22].

After the operation date, contraventions were reported to be due mainly to inadvertence and the Health Committee took the view that cautionary action was sufficient. There were very few subsequent offences, with no legal proceedings being necessary. Most people expressed approval and the public acted as voluntary 'inspectors'[23].

According to the Annual Report of the Manchester Health Department 1955-6, commenting on the smokeless zone programme:

"The result (of the initial zone) was so spectacular during its initial winter period, 1952-53, that an adjoining area was surveyed early in 1953, and this first proposed extension was approved by the City Council and the declaratory Order was submitted to the Minister of Housing and Local Government. Public approval of the central smokeless zone continued during the second year of its establishment and consequently, without waiting for approval for the first marginal extension, two further contiguous areas were surveyed during 1954. The necessary orders were made by the Corporation and the three marginal extensions were approved by the Minister during the year. The orders will become operative on the 1st May 1955. This date has been selected to give adequate time for the necessary alterations to be carried out when heating demands are slight and to minimise any risk of inconvenience to the occupiers in the zones."[24]

An indication of the degree to which the zones were already smokeless is given by the following figures[24]:

	Numbers of Appliances	
	Total	*Smokeless*
Extension No. 1	6,694	5,115
Extension No. 2	1,208	798
Extension No. 3	6,133	4,987
Total	14,035	10,900

Therefore, about 78% of the appliances in use were already smokeless and the Department had the assurances of solid smokeless fuel suppliers and of the North West Gas and Electricity Boards that the needs of the zones could be met.

Closer examination of the detailed survey of appliances involved in the No. 1 extension indicates that, of the 1,579 not being operated smokelessly, 1,002 were open grates capable of burning solid smokeless fuel and of operating smokelessly if gas pokers were used[24]. Of 356 boilers, 313 used solid smokeless fuel but needed gas pokers to be made smokeless during lighting up. Of the remainder, 41 had mechanical stokers and two were hand-fired. They emitted occasional smoke and may require reconstruction or conversion to comply with the smokeless zone. Of 132 heating stoves, 104 used coke and the remainder could do so and all could be made smokeless with gas pokers. The remaining 89 appliances were kitchen ranges of which 85 used coke or other smokeless fuels but needed gas pokers. Four ranges needed to be replaced by smokeless fuel appliances. The details for the other zones was essentially the same. The use of two incinerators was to be avoided by arranging for refuse collection, and it was recognised that 12 bacon-smoking chambers must unavoidably emit some light smoke.

A convenient aspect of the new programme was that the absolute standard made offenders so obvious they were quickly reported by the public or neighbours.

Once the precedent had been created in the central area of the city, and success achieved, it was a routine matter to extend the central zone until it covered the major areas of like character in the city centre totalling 412 acres. Five development areas were also made smokeless as extensions of the central zone and became operative from 1st August 1955[25].

Neither established housing nor industrial areas could be included in smokeless zones. Industry presented particular problems which prevented certain operations being completely smokeless (hence the 'permitted periods' regulations). For housing, finance was only available from the Government in connection with Housing Act "improvement grants" for replacing old grates in existing dwellings. Since Council finances were organised to be in keeping with Government finance policy, rate and loan money could only be used for modernising appliances in a very limited range of premises, such as churches. To create smokeless zones by decree in established housing areas was, therefore, out of the question, assuming individuals would not be prepared *en masse* to pay the whole cost of conversion. An attempt was made in 1954 to persuade residents in housing estates in Wythenshawe area, with suitable appliances already installed, to agree to an experimental voluntary smokeless zone being created[26,27,24].

The Wythenshawe area represented the Council's pioneering efforts in more than one respect. In 1930 the Manchester Council acquired the Wythenshawe housing estate, ahead of public opinion, to house population overspill. Experimental coke burning grates had been installed in the area in 1935. The Housing Department was willing to provide safety connections for gas pokers if the tenants agreed to the smokeless zone. The tenants were reported to be reluctant because certain smokeless fuels had not given satisfaction in use. The problems were investigated[24] but the area was never included in the smokeless zone programme[28].

During the 1940s the NSAS had campaigned for municipal housing schemes to include smokeless appliances and in 1948 the Minister of Health asked that this be done. The Manchester Corporation had experimented with coke grates in 1935 but it was not until the 1956-7 Annual Report of the Health Department that we find the note:

"In addition, all future redevelopment areas will be declared to be smokeless zones . . ."

There is, of course, a difference between putting coke-burning grates in and requiring the tenants to operate the grates smokelessly. Once the principle was established, ten redevelopment areas were made smokeless in just over three years.

By November 1958 a total of 14 smokeless zones involving 522·64 acres and 4,764 premises had been created. No further zones were ordered after powers to create smoke control areas under the Clean Air Act 1956 became available, because exchequer grants towards conversion costs were only available under the national legislation.

The NSAS promoted the idea of smokeless zones[29] and several authorities acquired local act powers to put the idea into operation. Following the London Smog in 1952, the NSAS and the Sanitary Inspectors' Association recommended to the Committee on Air Pollution[30] that general legislation should provide the power for establishing smokeless zones. Some people even before the 1946 Act believed the creation of smokeless zones could be extended to cover the whole country[3]. Comments made on a television documentary in January 1953 by J. Lawson who had just supervised the operation of the first smokeless zone indicate the 'official' attitude at the time:

"The policy of creating smokeless zones is intended to secure the gradual elimination of atmospheric smoke by progressive expansion of an initial smokeless area.

The rate and direction of expansion will be determined by local conditions (involving the minimum disturbance of existing arrangements) and by the availability of smokeless fuels and suitable appliances.

The creation of additional smokeless zones in Manchester is a matter for the City Council to decide but I may say that close consideration is being given to this matter at the present time." [17]

Apart from the central area a major programme would axiomatically begin to windward, and this meant Wythenshawe (stated during the broadcast but not recorded, Lawson pers. com.).

The first part of this article, entitled "The First 100 Years (1830's to 1930s)" was published in the Autumn 1976 issue of 'Clean Air'.

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Part 2 Table 2

PROGRESS IN DOMESTIC SMOKE CONTROL IN MANCHESTER 1928-1957

(Events not originating in Manchester are bracketed).

Date	*Method*	*Measure*	*Source*
1935	1. Housing Committee to install experimental grates; 2. Town Hall Committee to experiment with fuel; 3. Gas Committee report on fuel production.	Report adopted	M/C Council
1935	Smokeless zones	Suggested	C. Gandy Chairman NSAS

Date	*Method*	*Measure*	*Source*
1939	104 acre smokeless zone excluding domestic	Deputation	NSAS to M/C Health Committee
1939	104 acre zone surveyed	Recommended	M/C Health Committee
1939	Sub-Committee on Smokeless Fuels	Appointed	M/C Council
1942	Put smokeless grates in postwar reconstruction	Suggested to Government	NSAS
1945	Local Act powers sought: 1. To make smokeless zones; 2. To make new housing smokeless;	Request to General & Parl. Committee	M/C Health Committee
1945	Local Act powers: 1. Recommended 2. Not recommended:	Report of Gen. Purpose Committee	M/C Council
1945	Local Act power (1)	Approved	Meeting of Electors
1964+	Promoted policies 1. Fuel supplies; 2. Smokeless appliances in municipal housing; 3. Lower fuel and power costs; 4. District heating and smokeless zones.	Policy statement	NSAS, N.W. Divisional Council
1946	Smokeless zones	M/C Corporation Act 1946	City Council
(1947	Fuel policy favouring smokeless fuel, including subsidy for old grate replacement and prohibit sale of non-smokeless appliances.	National Domestic Fuel Policy	Simon Committee)
(1948	Fuel Efficiency Committee	Reconstituted	Ministry of Fuel & Power)
1948	Make Government financed housing smokeless	Conference resolution	NSAS M/C
(1948	Improved appliances to go in housing schemes of local authorities	Ministry request to authorities	Ministry of Health)
(1949	Require smokeless appliances for improvement grants	Housing Act Circular	Ministry of Housing and Local Govt.)
1949	104 acre area resurveyed		M/C Health Committee
1949	Operation date of first smokeless zone in M/C to be 1/5/52	Resolution	M/C Council
(1949	National Survey of Source and Incident of Atmospheric Pollution	Report	NSAS Annual Conference)
1950	Publicity in Manchester	Exhibition	NSAS
(1951	Develop semi-coke	National Fuel Policy	Ridley Report)
1952	Central smokeless zone	Operational	M/C Health Department
1953	Extension of central zone for further details of smokeless zone programme see Table 2.	Survey done	M/C Health Department
(1953	Inquiry	Committee under Sir Hugh Beaver	Ministry of Health)
(1954	Final Report 1. Establish smokeless zones and smoke control areas in black areas to reduce smoke 80% in 10-15 years; 2. Clean air national policy; 3. Make Govt. appliances smokeless; 4. Make new estates smokeless; 5. Pass a new Clean Air Act. 6. Give conversion grants; 7. Require smokeless grates in new premises; 8. Establish a Clean Air Council)	Committee under Sir Hugh Beaver	Beaver Committee
(1956	Beaver recommendations implemented	Clean Air Act 1956	Government)
1957	1. Start at Wythenshawe and work north to cover whole city; 2. Appoint extra staff; 3. Pass necessary bye-laws; 4. Make corporation estates smokeless as programme proceeds; 5. Require tenants to use smokeless fuel; 6. Make corporation buildings smokeless and reduce SO_2	Report adopted by Council	Special Sub-committee re Clean Air Act
1957	St. George's smoke control area	Surveyed	M/C Health Committee

The Edinburgh Conference

The Lord Provost of Edinburgh opening the Conference on Monday evening

After a space of nineteen years, the Clean Air Conference was held in the Assembly Rooms and Music Hall, George Street, Edinburgh from 11th October to 15th October 1976. The weather was mixed to say the least but fortunately the Wednesday, on which many of the visits were made, was a really beautiful day.

Some 350 delegates attended the Conference and although this number does not compare very well with former years, having regard to the economic state of the country, it was quite gratifying. All sessions were very well attended; the papers, which were of a high standard were well received and all resulted in lively discussion periods. Compared with the wide spectrum of the Brighton Conference in 1975 when International matters were given consideration, the subjects at Edinburgh were perhaps more down to earth and certainly more applicable to the work of local authorities and industries in this country. Perhaps because of this, the Conference had a greater appeal to the delegates, most of whom seemed to have thought that the right ' mix ' was achieved.

The Opening Session took place on the evening of Monday, 11th October. Unfortunately Lord Kirkhill, the Minister of State at the Scottish Office, who was due to open the Conference was, because of Parliamentary business, unable to do so at the last minute. The Lord Provost of Edinburgh, the Right Honourable J. Millar, very kindly extended his welcoming address and opened the Conference on behalf of Lord Kirkhill. The Society's President, Professor P. J. Lawther, gave his usual invigorating address in which he emphasised the necessity of retaining a sense of perspective and proportion about air pollution. Too many people were being frightened by statements made about pollutants which had no medical or scientific evidence to support them.

On Tuesday morning, the Conference proper opened with a working session on noise. Dr A. J. Crosbie, the senior Lecturer in the Department of Geography at the University of Edinburgh, presented a paper on ' Noise as an Air Pollutant ' and Mr J. H. Richardson, Senior Consulting Engineer of Acoustic Technology Ltd, presented a paper on ' Industrial and Local Authority Approach to Neighbourhood Noise '. Smoke control was the theme for the afternoon session and Mr W. J. S. Batho of the Department of the Environment, reviewed the present position and the way ahead while Mr L. Mair, the former Director of Environmental Health of the City of Newcastle upon Tyne, gave a paper on ' Smoke Control in an Industrial Area; Experience in North East England '.

The session on the morning of Wednesday was devoted to one paper only, a paper which could have far reaching effects on the legislation on air pollution control in this country. Sir Brian Flowers, FRS, recently the Chairman of the Royal Commission on Environmental Pollution, presented the Findings and Recommendations of the Royal Commission as set out in their Fifth Report. Sir Brian developed his theme at length and then Mr W. F. Lester of the Severn-Trent Water Authority spoke on behalf of the water industry as a whole and gave the views of that industry. Needless to say, these did not agree with some of the recommendations and views put forward by Sir Brian. This resulted in a first class debate in which it was clear that some delegates thought that the Royal Commission's recommendations did not go far enough, while others thought that there was little reason for change.

Refreshments at the Reception and Dance on Tuesday evening

Following the Extraordinary General Meeting of the Society, the Thursday morning session opened with a paper by Professor M. Howe of Strathclyde University on ' People, Pollution and Retribution '. This philosophical presentation by Professor Howe caused many people to think but did not provoke as much discussion as might have been expected. Prof. Howe's paper was followed by a paper on ' Rural Pollution —the High Peak, Derbyshire ', prepared by the Health Department of the High Peak Borough Council and presented by Mr. Ian Holmes, the Area Environmental Health Officer. This was a survey in depth of an area, which to a large extent depends for its living on the tourist industry but which is trying to develop its own indigenous industry. The control of pollution in rural areas is therefore of great significance.

Sir Brian Flowers on the Wednesday morning

On the Thursday afternoon, 'Solar Energy' was the title of the session which was open to the general public and students from senior schools, polytechnics and the universities. A better title for the session in the event would have been 'Alternative sources of Energy'. Dr. J. C. McVeigh of Brighton Polytechnic developed this theme and then Messrs Brunt and McNelis discussed varying aspects of solar energy, its use and its possible future developments.

The final session on Friday morning was given over to one subject when Dr D. H. Sharp of the Society of Chemical Industry spoke on the disposal of toxic and radioactive wastes. Inevitably, because this was the last session of Conference, there was some falling off in attendance; but this did not mean that the subject was not very fully debated, and in fact the Chairman had to work hard to ensure that the session finished in reasonable time.

Visits and social events were not neglected. On the Tuesday morning a party made a coach tour of Edinburgh when unfortunately, because of the very heavy rain, they were unable to see all they would have liked. That evening the Conference Reception and Dance was held in the Assembly Rooms, and on the Wednesday afternoon, fortunately a very fine afternoon indeed, two coach loads of delegates and their wives toured the Scott country. This proved an extremely popular visit. Meanwhile technical visits were being carried out at the Grangemouth Oil Refinery, Scottish Rexco at Comrie Colliery, the Caledonian Distillery and the Fountain Brewery at Edinburgh. We are reliably informed that there was sampling of products at the distillery and the brewery but those delegates who went to Grangemouth and Comrie did not come back either with any oil or any solid smokeless fuel!

The golfers, of course, were out in force at the Bruntsfield Links Davidsons Mains, and a battle was joined in a Stapleford Tournament for the SSFF Trophy. This was won by Mr. W. Meredith of Portsmouth. All those who took part had a splendid afternoon; the course was in excellent condition, the weather was fair and the golf enjoyable.

Thursday was another pouring wet day but this did not damp the enthusiasm of the party of delegates and wives who made a conducted tour of St. Giles Cathedral and Edinburgh Castle. Undoubtedly they got wet, but we are glad to be able to report that none were any the worse for this and they all thoroughly enjoyed their tour.

On the Thursday evening, the Lord Provost and members of the Edinburgh City Council entertained the members of the Council of the Society to a reception in the Council Chambers.

So altogether the Edinburgh Conference provided a very full week. This time there did, indeed, seem to be something for everyone and this was generally regarded as a very successful Conference; the only disappointment being that there were not more delegates.

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POLLUTION ABSTRACTS

Papers presented to the 43rd Clean Air Conference, Edinburgh, 11-15 October 1976

NOISE

44 Noise as an Air Pollutant. Dr A. J. Crosbie, Department of Geography, University of Edinburgh.

The origin of noise pollution is shown to be in energy released as sound in the medium of air. The history of concern about noise is noted, and reference made to the subjectivity of reaction to noise. Measurement of noise is examined in detail. The complex methods and units employed, and factors influencing temporal variations in noise, are described. The mathematical relationship of the dissipation of sound waves with distance is illustrated. Discussion of threshold levels of noise includes assessment of human response to noise variables and of the indices devised to attempt objective analysis of noise levels. The effects of noise on both buildings and people are examined. Special attention is paid to human response, which is shown to fall into three categories; physiological, psychological, and annoyance, each of which are considered in detail. Three major sources of noise are discussed: road traffic, as the most pervasive source and one which illustrates general problems of noise control; aircraft noise, as a modern product for which changes in noise levels and controls are both subject to technological change; transistor blight, a by-product of modern habit and an example of individually-caused nuisance which shows the subjective and aesthetic factors that influence both producers and sufferers of noise. In conclusion, three features distinguishing noise from chemical air pollution are characterised, and their future possibilities in progress towards control are described.

45 Industrial and Local Authority Approach to Neighbourhood Noise. Mr J. H. Richardson, Senior Consulting Engineer, Acoustic Technology Ltd, and Mr R. W. Smith, Consulting Engineer, Acoustic Technology Ltd.

This paper is concerned with the effect of industrial noise on the local community or neighbourhood. It outlines the various methods available to assist Local Authorities and Industry to reach agreement on controlling community noise. An explanation of acoustic terminology is made, including a summary of measurement units. An assessment of neighbourhood noise level criteria contains references to existing standards and regulations, and their application. Problems of neighbourhood noise measurement are discussed, with an outline of alternative measurement systems. Neighbourhood noise prediction is often a necessary consideration when planning permission for industrial works is sought. References are given to determine the sound propagation characteristic between the source and the community. In case exceptional conditions render the application of standard procedures doubtful, a typical propagation study is illustrated. The difficulty of reconciling the conflicting interests of industry and of the community is usually left to the LA to resolve. A table is presented of estimated community response to noise, and some of the typical problems that can arise are outlined. The final section of the paper presents six very different case studies as illustrations of the way in which the problems of neighbourhood noise have been tackled by both Local Authorities and 'Plant' owners, with the advice of noise consultants. The solutions adopted include the use of noise control hardware, modifications to site layout, changes of operating times and procedures, etc.

SMOKE CONTROL

46 A Review of the Present Position and the Way Ahead. Mr W. J. S. Batho, Department of the Environment.

The introduction refers to setbacks in smoke control since 1973, when the last DoE paper on the subject was given at an NSCA conference. A possible view, not held in Whitehall, might be that smoke control should take a back seat because of the energy and financial crises since that date. The DoE view is that priorities must be established but the 'death' of smoke control is an exaggeration; statistics are presented to show progress and costs of implementation. With the reorganisation of local government, and the end of distinction between 'black' and 'white' areas, local authorities drew up new targets for smoke control. A table is given of these figures, by area. Regional variations in achievement of targets can clearly be seen. Two reasons are identified, one related to the enthusiasm of individual authorities and the other to local economic considerations. The role of central government in programmes is discussed. Under smoke control grant arrangements, central government has no power to control LA policy until an order is presented for financial approval. The argument as to whether Locally Determined Sector or Key Sector financing should be used is considered. The history and role of Clean Air Councils completes this review of the current situation. Roughly the same problems have persisted for the past 20 years. With UK entry into the EEC, changes are predicted. An explanation is made of the EEC Directives' procedure, and their effects on member states. Particular reference is made to the proposed Health Protection Standard, and the potential importance in this context of smoke control as carried out under the Clean Air Acts (much admired by fellow EEC members). It would be appropriate if this proven success should contribute to a co-ordinated effort within the EEC.

47 Smoke Control in an Industrial Area; Experience in North-East England. Mr L. Mair, formerly Director of Environmental Health, City of Newcastle upon Tyne.

Mr. Mair characterises the topographical, industrial and socio-economic nature of the North East region, concentrating on Tyneside and Newcastle upon Tyne. He shows that it was difficult originally to win acceptance for a policy of domestic smoke control. High coal consumption in the region was promoted by respect for and dependence on its own product, and by the northern climate. Economically, the claims of smoke control had to contend with other unwanted legacies of the industrial revolution. The magnitude of the task of cleaning the air is described, together with efforts made to encourage local enthusiasm and the tentative beginnings of smoke control programmes. The author examines the difficulties which dogged progress throughout the sixties and early seventies, leading to the investigation by a specially instituted Panel in 1972. This stimulated renewed activity, but the effect of government circulars on rate fund expenditure, 1974/1976, is shown to have curtailed this improvement. This gloomy position is lightened by tables which show the number of smoke control programmes in operation, and improvement in the figures for atmospheric smoke and SO_2 concentrations.

THE CONTROL OF AIR POLLUTION

48 The Findings and Recommendations of the Royal Commission on Environmental Pollution. Sir Brian Flowers, FRS.

Having as its terms of reference 'To review the efficiency of the methods of control of air pollution from domestic and industrial sources, to consider the relationship between the relevant authorities and to make recommendations', the Royal Commission made 94 recommendations in their Fifth Report. These ranged from those concerned with domestic smoke control, the best practicable means and air quality guidelines, through enforcement, registration and consents, to planning and to the establishment of a unified pollution inspectorate dealing with the control of all forms of pollution—air, water and land. Sir Brian Flowers did not detail all the recommendations in his paper. He concentrated on outlining the three issues central to the report, having first explained what the Commission envisaged as the future roles of the Alakli Inspectorate and local authority environmental health officers in the control of emissions from difficult industrial processes. A clear distinction is drawn between emissions *to* air, and air quality generally, the object of policy being to obtain acceptable air quality by means of controlling emissions. The Commission did not advocate rigid air quality standards, but wanted air quality *guidelines,* to indicate whether bpm were evenly balanced. There must be flexibility to take account of local circumstances. The second theme is that air pollution cannot be considered in isolation, its ultimate source being some industrial process that pollutes more generally. Examples are given of the transferability of pollution from one medium to another. This was the logic behind the recommendation for a unified pollution inspectorate—HMPI, which would use bpm to reduce arisings of all forms of pollution from particularly difficult industries, rendering harmless whatever might be emitted, but which would *not* encroach upon the normal responsibilities of WDAs and WAs. The final issue discussed is who, within the government, should be responsible for pollution control and for control over the quality of the environment generally. Sir Brian justifies the recommendation which would transfer the Alkali Inspectorate forthwith back to the DoE, by distinguishing between the tasks and objectives of the Alkali and Factory Inspectorates, and emphasising the preferability of closer links between the LAs, WAs and the control inspectorate of the future. This, the Commission sees as essentially a more broadly based version of the Alkali Inspectorate, with greater public accountability.

POLLUTION URBAN AND RURAL

49 People, Pollution and Retribution. Professor G. M. Howe, University of Strathclyde.

Improvements in standards of hygiene and environmental health have produced great increases in the average expectation of life in the UK since 1840. In each case it is shown that the response to pollution or degradation associated with the atmosphere, water supply, food, land and soil, housing, occupation, etc., is conditioned by the genetic make-up of the individual. Prominent, selected factors are considered separately, although it is stressed that in practice they constitute a whole. The value of the 'episodic relationships', found by correlating daily or weekly morbidity rates with indices of air pollution during short-term acute pollution episodes, is discussed. Reference is made to studies on the health effects of air pollutants other than SO_2, smoke, grit and dust, etc., and to the effects of atmospheric pollution on mental well-being. Three ways in which water pollution can harm human health are noted: by the ingestion of waterborne bacteria, in the recreational use of water and the pollution of sea-food, and in the link between soft drinking water and cardiovascular disease. Food is shown to be contaminated both by animal infections growing within and more recently by chemicals entering the human environment from a variety of industrial sources. Disposal of toxic chemicals also leads to the contamination of soil, food and water and can produce excessive uptake of toxic trace-elements in growing foodstuffs. Studies regarding the influence of poor housing on health have produced conflicting results: design faults, odours and noise can be considered within this category. New consumer products have potential new hazards which add to traditional accidents risks in the home. Occupational hazards, i.e. health and safety at work, involve a wide range of risk sources; mention is made in this review of dusts, vapours and nuclear radiation. Noise effects vary from nuisance to actual hearing loss, and frequency is an important factor in hearing damage. The general effects of modern urban environments are also mentioned, with particular reference to 'stress'. The conclusion of this review emphasises the need to determine the real and lasting effects on man's health and general well-being of changes brought about in the balance of the natural forces and of the new environment being created by man.

50 Rural Pollution—The High Peak, Derbyshire (with particular reference to stone quarrying). Mr I. Holmes, Area Environmental Health Officer, Borough of High Peak.

A general introduction characterises the geography, population and economic resources in the Borough of High Peak. Ninety-three per cent of the area is within the Peak District National Park, a major recreational attraction for neighbouring Greater Manchester and adjoining northern industrial areas. Tourism and industry are equally important to High Peak, and when the 1974 reorganisation of local government brought the present borough into being, it was thought vital to make a study of local pollution problems. Eight sources of air pollution were defined in order of priority, noise problems were also discussed, and a future control policy was formulated. The Council's administration of this control is described. Particular attention is given to the long-established quarrying industry. An appendix itemises the division of responsibility for environmental control in this industry between H.M. Alkali and Clean Air Inspectorate and the BC's Environmental Health Department. The history and importance of the quarrying industry in the area is outlined. Four forms of pollution associated with the industry are discussed in detail: noise, dust, smoke and wastes. The origins of pollution and methods of control are examined in each case. The High Peak BC was instrumental in the establishment of a Local Liaison Committee, which secures public participation and the dissemination of information on pollution and its abatement. Other industrial problems in the area are outlined, with particulars given of efforts made to 'landscape' new works. Ad hoc committees have been established to open communication between residents and industries. The success of these committees will, it is hoped, lead to the establishment of a Pollution Prevention Panel. In the meantime, the Council maintains an industrial service and extensive monitoring activities (for the National Survey, for dust and specific other pollutants, and for noise).

SOLAR ENERGY

51 Energy Sources: What are the Alternatives? Dr J. C. McVeigh, Head of Mechanical Engineering, Brighton Polytechnic.

This paper reviews the major alternative non-polluting sources of energy, particularly concentrating on wind power and solar energy. The introduction expresses disappointment with the way in which these sources had been dismissed at the National Energy Conference in June 1976. Mention is made of the various forms of pollution associated with conventional sources of energy. But the primary flow of energy-giving life comes from the sun, and the fundamental mis-match is between energy demand and the supplies which can be obtained from the sun. It is explained that, although unevenly distributed, overall the radiation climate of the UK is perhaps half as good as that of the best countries. However, in a vast secondary source of energy, the wind deriving from solar energy, the UK is particularly fortunate since the strongest winds occur in winter and wind power can be harnessed directly to provide heat when the demand is greatest. The history of research on solar energy is reviewed, and a summary given of present available applications in water heating, space heating, power applications and direct electrical generation. The following sources of energy are discussed briefly: wind, geo-thermal, tidal power, and wave energy. Energy conservation techniques are also considered. The exclusion of draughts and the insulation of lofts and cavity walls will produce a dramatic reduction in the overall heat losses. Finally, the author asks whether it is necessary to relate 'standard of living' to increased energy consumption, or whether a much better quality of life can be achieved by investing in alternative sources of energy and abandoning an increasingly expensive and environmentally damaging nuclear programme.

52 The Scope for Solar Energy in the Energy Pattern of the Future. P. Brunt, General Technology Systems Ltd.

Projected energy demands, based on the present trends in population increase and the growing demands of the Third World countries, reach some 16 times the present level. Nuclear energy, hydro power, geothermal energy and solar energy will be left as alternative sources when the increasingly expensive fossil fuel resources are finally depleted. It is shown that of these, solar energy has no overwhelming drawbacks, and several very attractive features. The paper highlights the factors having an influence on the exploitation of solar energy as a significant contribution to the world's energy sources. The wide range of current and future applications are illustrated. Factors influencing the large scale exploitation of solar energy include the expense of collection; the current relatively low price of conventional fuels; and the need to improve the technical performance of solar equipment, and to obtain reduction in its cost. Tables show the costs of solar installation, the pay-back period, and comparative investment returns. Commercial and political decisions influencing the exploitation of solar energy are considered. The long-term potential, utilising space energy to harness solar energy, is also examined. The author concludes that there is a need for early and determined programmes of demonstration and development so as to ensure that maximum savings of non-renewable resources may be made using equipment which is economically competitive with conventional fuels.

53 The Utilisation of Solar Energy. Bernard McNelis, General Technology Systems Ltd.

The theory of photovoltaic cells is briefly outlined and examples of modules developed for terrestrial use by Ferranti in the UK and Solar Power Corporation in the USA (Lucas are responsible for UK marketing) are shown. Applications are described, including radio repeater stations in Scotland (Isle of Mull, Perthshire, Isle of Islay) and mention made of UK R & D in progress on silicon cells at Ferranti and Metals Research and cadmium sulphide—cuprous sulphide at International Research and Development, GV Planar and PATS Centre. The flat plate solar collector is described, with examples of various types manufactured in the UK, and mention of their application to space and water heating made, including a description of the 'solar village' at Loch Rannoch, Perthshire. Comment is made on the performance rating of collectors and the important efforts underway to develop standard test procedures is discussed.

WASTE DISPOSAL

54 The Disposal of Toxic and Radio-active Wastes. Dr D. H. Sharp, The Society of Chemical Industry.

The author was a member of the Key Committee, set up in 1964 to make the first study in depth of problems associated with the disposal of Toxic Wastes. Its 1970 Report drew attention to Local Authority reluctance to make provision in their area for toxic wastes, called for better facilities, and recommended expert authorisation. Much of this Report was later embodied in the Act. The author defines waste as unwanted material that leaves the factory of its origin and requires positive planning and action over its disposal. The term 'toxic' is analysed in detail, in order that the degree of hazard implied by this general term, not used in the Act, should be understood. Problems associated with safe disposal are detailed. A section devoted to land disposal discusses the formulation of a Code of Practice, in which the author took part. The essential elements of safe and rapid disposal are summarised, but it is emphasised that too many variables are involved to make practical the application of a common blueprint. Careful control, and above all the co-operation of all concerned, are essential factors in disposal. The problem of radioactive waste, and solutions applied, are examined in perspective in Part II of the paper. Reference is made to the powers and responsibilities of the authorities involved. The amounts of waste produced in the generation of nuclear energy is compared with that of fossil-fuel generated electricity. Radioactive emissions are briefly explained, with a list of the main problem isotopes, and their ½ life lengths. It is stressed that a long ½ life is not synonymous with danger. The general philosophy of dealing with highly active liquid waste is outlined, quoting D. W. Clelland. Examination is made of how radioactive waste is stored at present, with explanation of the alternative future method of vitrification. The conclusion emphasises the excellent safety record to date in radioactive waste disposal.

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NEWS FROM THE DIVISIONS

EAST MIDLANDS

Approximately 50 members assembled for a meeting on 1st July 1976 at the Conference House in Buxton where they were given an official welcome by the Deputy Mayor, Councillor H. H. Littlewood.

Councillor Allman, Leader of the High Peak Borough Council, outlined some of the environmental problems which arose from the quarrying industry, described the steps which had been taken to bring about discussion and voluntary improvements, and then introduced Mr A. R. Groom, Technical Manager of the Lime Group of the Mond Division of ICI, to describe the workings of the Tunstead Quarry which members were due to visit in the afternoon.

Mr Groom emphasised that whilst the facts he would be giving related to the ICI Tunstead Works, any opinion he expressed would be a personal one. He said the quarry faces varied in depth from 60ft to 160ft. A third "lift" was now under development down to railway level. Limestone was used to make soda ash—used in glass and detergents manufacture. Lime was manufactured in shaft, rotary and rotating hearth kilns. Lime was the cheapest form of alkali and was sold at a relatively low price compared with other parts of the world. Much of Tunstead's production went to the manufacture of steel but it also entered into a host of other activities. Stone was blasted from the quarry face by drilling holes 20ft back, to below the level of the quarry floor, filling the holes with explosive and then setting them off in sequence at intervals of 17 millisecs. This reduced the sound and vibration and also produced better rock fragmentation. People were becoming increasingly sensitive to noise and it became more and more necessary to think in terms of "silent quarrying"—if that could be achieved. The rock was brought down by blasting and then transported to the primary crusher to give a −10in minimum dimension. The stone was then graded into three sizes, the 9in to 5in going to the vertical kilns, less than 5in to the washing plant and the larger stone to a further crusher and thence to the screening house for grading into various sizes. Much was loaded direct to British Rail but some went to the chippings plant to feed the rotating hearth and rotary kilns. About one-third was sold for concreting and roadstone aggregates. Stone cannot be crushed so as to produce a required size grading. A range had to be accepted and an effort made year by year and hour by hour to balance production to sales demand.

Waste products were virtually nil, the only discard being mineralised clay from the quarry. Sand went for building, clay was fed to cement production on the site. Apart from heavy clay and some waste from the old shaft kilns everything went for beneficial use somewhere in the country.

Turning to quarries and Clean Air, Mr Groom quoted HRH The Duke of Edinburgh—"Every interest is partly conservationist and partly destroyer"—and said he personally was committed to the principle that one must accept the aspirations and wishes of others but that inevitably there must be a compromise with the well-being of the whole country in mind. For example, quoting from the Flowers Report—"Some prefer to breathe Clean Air in an atmosphere of Industrial bankruptcy". Mr Groom said he regarded "environment" as embodying all that made up our standard of living. Ten years ago the word acquired a capital "E" and the meaning became restricted. It would be convenient to deal with his comments under the headings of Dust and Grit; Smoke and Gases; Sound and Vibration; Objective measurements of those effects; and effects upon people, both objective and subjective. No scientific measurement would convince to the contrary a person who thought he was being affected. Until it was realised what the subjective inputs were there could be no coming together of thought.

DUST

For 101 years there had been powers for local authorities to deal with dust nuisance since the 1875 Public Health Act—but these had seldom been invoked. Mr Groom quoted a definition of nuisance given in the courts by Mr Justice Eady "Every person is entitled as against his neighbour to the comfortable and healthful occupation of premises enjoyed by him . . .". The ruling went on to indicate that the test was whether the act complained of was "an inconvenience more than fanciful, more than one of delicacy or fastidiousness materially interfering with the ordinary comfort of human existence not merely according to elegant or dainty modes or habits of living but according to plain and sober and simple notions among English people".

In any population there would be exceptionally sensitive people and exceptionally insensitive people. Some would be sensitive to dust but not to noise. Some would be sensitive to one type of noise but not to another. From 1971 the control of quarry dust from the entrance to the crushing plant to the time it left the works had been under the control of the Alkali Inspectorate. Some had seemed to believe that this would promote a change to near perfection overnight but control involved money and resources of all types. He drew the distinction between dust emission and dust deposition in the locality. The quarry measured about $1\frac{1}{4}$ miles × $\frac{1}{2}$ mile and there were four ICI deposition gauges positioned about $\frac{1}{2}$ mile from the major dust-producing plants. A local authority gauge was located downwind from Tunstead in respect of the prevailing wind.

The main plants at Tunstead would emit 300 tons per day without means of collection. The actual emissions and deposition readings were as follows:

Year	*Dust Emitted From Major Plants*	*Tons/Day From Quarrying Operations*	*LA Gauge mg/m²/day*	*Average Deposition Rate 4 ICI Gauges mg/m²/day*
1970	48	10	410	540
1971	36	8	230	440
1972	33	6	240	450
1973	34	3	300	400
1974	26	2	190	370
1975	21	2	270	310
Est. 1980	11	1		

Reductions of this order had been achieved only by the deployment of very considerable resources, human and monetary. The technical means for TOTAL elimination would be so costly as to throw an intolerable burden upon the consumer. There was no coffer of gold in Whitehall, in Local Government or in business which could be used to create improvement. The only thing which could fund such work was wealth created in this country. It could then be used to build cars or refrigerators, to import celery from California or to improve the living environment. The report on the Chequers Conference (Central Government, the TUC and the CBI) showed clearly how the Government had to balance its economic and social objectives—and these were often conflicting obligations. The Government was committed to increasing the National rate of growth in output which would mean giving priority to Industrial Development over consumption or even social objectives.

Returning to dust from the quarry, Mr Groom said there were recognised difficulties in defining the source. It was difficult to measure, but it had been attempted. Dust certainly came from blasting and by being whipped up from the quarry floor. By controlling dust from drills and also the cleanliness of the quarry floor the dust from the quarry had been reduced to about one-fifth between 1948 and 1975. In 1975 the dust from the quarry was about one-tenth of that from the plants, and as indicated above this is also the estimated future situation. This dust was rather like the fume from a steel works. It moved like a gas and fanned out like a chimney plume.

In regard to the dust deposition figures, he made two points:

(a) Whereas dust from Tunstead had been reduced by more than half since 1970 the dust around Tunstead had only gone down to 3/5 (from 540 to 310 mg/m²/day). The Local Authority gauge was more random. It was believed this was due to differences in wind direction. This showed that it was useless to have a single gauge. A matrix of gauges had therefore been established.

(b) The deposited dust had fallen by a smaller margin than dust emission. This was because some comes from other sources, eg other quarries and from far afield. The dust from Tunstead is super-imposed on the background deposition. It was believed that in 1975, of the dust deposition at the ICI gauges, about 30% came from Tunstead.

SMOKE

The emission of smoke was at one time a major effluent. The problem was now largely solved. That which remained arose from the coal-fired lime kilns and this was an intractable problem. Sanction had been given to convert these kilns to gas firing which would eliminate the smoke and reduce the dust to the level set by the Alkali Inspector.

SOUND

This came from vehicles, mobile plant and blasting. The Company had achieved success in abating noise from high efficiency kilns which required high draught rates. The noise produced by the fans had been dealt with by a novel type of silencer.

In regard to blasting noise and vibration, the face dressing blasts along the quarry top gave rise to most noise. People were sensitive to it and it remained a major cause for dissatisfaction.

WHAT TO DO?

(a) Monitor constantly and check that what was supposed to be happening IS in fact happening, eg that dust hoppers are being emptied. Monitoring without control was of no use. There had to be a total commitment to improvement by all.

(b) Sharing

Until five years ago industry had tended to set itself apart. No one was convinced of anyone else's integrity. More recently two Liaison Committees covering the quarrying areas near Buxton had been set up by the Alkali Inspector. These bring together the quarrying companies Public Health Officials, and interested persons. There were few rules. The chairmanship was shared between the industry and the people. Although the public were entitled to know what went on, no good purpose would be served by selective reporting of controversial items. The two Chairmen therefore approved statements which went to the District Council and the Press. Each member was honour bound not to abuse the confidence of the free discussion which had thereby become possible. When meetings were attended by responsible people industry could and did respond openly. Now companies were prepared to disclose information which five years ago would not have been considered possible.

Mr Groom's address was greeted with sustained applause and he then answered questions about comparisons with other countries in the European Community; costs of dust collection and the rate of increase of cost with increased stringency of limits; the measurements of noise; the disposition of measuring gauges; possible health implications of limestone dust, and the performance of dust arrestment plant both as regards efficiency and maintenance of performance in relation to design standards.

Thanking Mr Groom on behalf of the Division, Mr T. Henry Turner said that the Society had connections with ICI in the past through people like Dr Nonhebel. There were numerous types of mineral working and some had been mitigated by successful rehabilitation. Mr Turner hoped this might be possible with the limestone workings.

Thanks were also expressed to Councillor Allman and the High Peak Borough Council for their interest in the meeting and in the Society generally.

In the afternoon members went by coach to the Tunstead Works where they were shown the extent of the quarry and the various other aspects of the undertaking. Plants visited included the lime kilns and their associated dust arrestment plant and also the crushing plant with its very impressive facility for crushing the very largest lumps of limestone. The three levels mentioned at the morning talk were seen. Another interesting facet was the experimental rehabilitation work where grass could be seen growing on the limestone quarry faces and floor.

At the end of the visit members were given refreshments in the works canteen, and the interest evinced was clearly demonstrated by the many questions, which had to be brought to an end because of time considerations. The Chairman of the Division, Councillor W. R. Cashmore, expressed warm thanks to both Mr Groom and Mr Anderson and to all our guides who had been at pains to explain the operations at Tunstead and had also answered many questions on the way round the quarry.

Driving along the A619 Chesterfield to Worksop Road it is quite easy, as I discovered, to miss the entrance to Ringwood Hall in Brimington, once the stately home of Charles Markham, a former Managing Director of Staveley Chemicals Ltd., but now the Company's Social and Recreation Centre. Here it was that some 55 members of the Division met on 9th September, 1976, by kind invitation of the Staveley Company.

After coffee the Divisional Chairman, Councillor W. R. Cashmore, introduced Mr. W. H. Tomlinson, Managing Director of Staveley Chemicals, who welcomed the members to the Staveley Works. He said that in the past 15 years there had been many changes, most notably from a situation where the main function was ironmaking and chemicals were peripheral, to one where the interest was almost entirely in chemicals. There had been some daunting challenges but it had been an exhilarating experience resulting in a viable organisation which had preserved jobs for many hundreds of people. The name had been changed many times but Staveley had been retained and was respected in the Chemical Industry. Whilst the activities made a contribution to air pollution the firm liked to think that this was minimised and that they exercised responsibility. They had an important contribution to make ta the reduction of air pollution as members would hear from Mr. Wheatcroft.

The Chairman introduced Mr. J. B. Wheatcroft, Development Director of Staveley Chemicals Ltd., who then gave a paper entitled "The use of SO_3 for the improvement of mechanical and electrostatic Dust Precipitation". Following the presentation of the paper there was a lively flow of questions and discussion ranging over possible applications in lime burning, the more detailed points of how the SO_3 assists in precipitation, comparison with EEC countries, metering and transportation of materials. A vote of thanks to Mr. Wheatcroft was proposed by Mr. J. B. Brackenbury, Chief Environmental Health Officer of Chesterfield.

Members were then entertained to lunch by the Company and were joined by Mr. E. M. Summers, Managing Director, British Steel (Chemical Division). Thanks for an excellent meal were expressed by the Divisional Chairman, Councillor Cashmore. Owing to the extent of the works, buses were needed to take the party to the various processes. This operation was smoothly carried out, the only minor detraction being a cool, gusty wind reminding us that the long, hot summer had ended twelve days ago!

It is hoped that it will be possible to publish text of Mr. Wheatcroft's paper in 'Clean Air' in due course.

E. F. Raven
Hon. Secretary

LONDON, SOUTH EAST & CENTRAL SOUTHERN DIVISIONS

Visit to Chloride Automotive Batteries Ltd., Dagenham

A small party consisting of ten members and representatives visited the above factory on 16th September 1976. The tour of the works revealed the various stages in the manufacture of vehicle batteries and particular interest was shown in the methods of air pollution.

This was followed by a detailed discussion with several members of the staff and considerable interest was shown in the methods taken to safeguard the health of the employees engaged on the hazardous processes taking place in parts of the factory.

The visit proved to be extremely interesting and was very much appreciated by all the members of the party.

B. C. Upton
Hon. Secretary

NORTHERN

On Friday, 29th October, 48 members were welcomed by the Deputy Mayor of the City of Carlisle to the first meeting of the Division to be held in the city.

Members were disappointed that the Parliamentary and Local Government Committee of the Society were unable to support their objections to Circular 54/76—Revised Grant Arrangements. It was reluctantly accepted, however, that little further action could be taken at the moment.

A short talk on ‘Smoke Control in the Current Economic Climate’ was given by Mr. J. Hill, M.B.E., Chief Environmental Health Officer of Langbaurgh B.C. Mr. Hill spoke on the need to keep smoke control programmes alive and moving, albeit if necessary in some areas on a reduced scale. Smoke control is a non-recurring, one off, expense he pointed out and encouraged members to exert the maximum pressure on their councils not to lose the impetus produced by the Sheard Committee investigations into smoke control in the North East.

Mr. M. S. Ankers, Principal Environmental Health Officer (Noise Control) Manchester City, presented a paper on Noise and the Control of Pollution Act 1974. After a brief historical review of noise legislation prior to the Control of Pollution Act, Mr. Ankers spoke at length on the new provisions contained in Part III. He had reservations about the effectiveness of the sections dealing with noise abatement zones and some of the powers relating to construction site noise, but was happy with the improved methods for controlling noise nuisance. Mr. Ankers described what was probably the first case in the country where an individual householder had successfully taken legal action in respect of a noise nuisance and ended with a personal plea for elected representatives to recognise the problems of regular evening work, the cost of essential equipment and the need for trained specialist staff, etc. if noise control work was to flourish.

C. R. Cresswell
Hon. Secretary

DIARY OF EVENTS

9th-10th March (Wednesday and Thursday)
NSCA 6th Technical Seminar—NOISE.
Manchester.

4th May (Wednesday)
London, South East and Central Southern Division.
Annual General Meeting.
County Hall. 2.15 p.m.

12th May (Thursday)
p.m. General Purposes and Finance Committee Meeting.
London.

2nd June (Thursday)
p.m. Meeting of the Council of the Society.
London.

New Smoke Control Orders

The lists below are supplementary to the information in the last issue of **Clean Air (Autumn 1976)** *which gave the position up to* **30 June 1976.** *They now show changes and additions up to* **31 December 1976.**

Some of the areas listed are new housing estates, or areas to be developed for housing. The total number of premises involved will therefore increase. An asterisk denotes that there have been objections and that a formal inquiry has been or will be held.

The list of new areas in operation of smoke control is based on the plans submitted to the Department of Environment, but may erroneously include some local authorities who have made postponements, without notifying the Ministry of the fact.

ENGLAND

NEW SMOKE CONTROL ORDERS IN OPERATION

Northern

Carlisle Nos. 1-4; Darlington No. 13 (Albert Hill) and No. 14 (South); Gateshead No. 1 (Highfield, Rowlands Gill) No. 2 (Old Ford) No. 3 (Carr Hill) and No. 4 Portobellow); Halton No. 17 (Runcorn No. 12); Hartlepool No. 30; Middlesbrough No. 18 (Ayresome St / Devonshire Rd) No. 19 (Town Centre) and No. 21 (Nunthorpe); Peterlee No. 4.

North Western

Blackburn Nos. 16 and 17; Bolton Nos. 4 and 5 (Bolton B. Nos. 50 and 51); Brierfield No. 8; Chorley No. 1; Colne No. 11; Ellesmere Port No. 13; Halton No. 16; Manchester (Cheetham); City of Manchester (Ringway); Preston Area Nos. 34-36; Rochdale No. 3 (Archer Park/Middleton); Rossendale No. 1; S. Ribble No. 3; St. Helens (Ashton No. 2); Stockport (N. Reddish/Heaton Chapel); Tameside (Ashton No. 17) (Audenshaw No. 8) and (Stalybridge Nos. 17-19); Trafford (Hale No. 6); Trawden; Warrington B.C. No. 1 (Stockton Heath/Grappenhall) and No. 2 (Thelwall); W. Lancs. (No. WL2); Widnes B.C. No. 14; Wigan No. 13.

Yorkshire and Humberside

Calderdale No. 1 (Ripponden) No. 3 (Hebden Royd-West End) No. 11 (Todmorden, Portsmouth/Cornholme/Pudsey/Vale) and No. 21 (Halifax-Bradshaw/Warley/Wainstalls); Craven No. 1 (Glusburn-Part); Dewsbury C.B. (North Eastern); Doncaster No. 1, No. 2 (Conisbrough) No. 5 (Hexthorpe) No. 6 (New Park) and No. 7 (St. Luke's); Kirklees Nos. 14 and 15 and No. 18 (Huddersfield); Rotherham No. 4 (Greasbrough) No. 6 Rawmarsh) and No. 17 (Swinton); Sheffield No. 28 (Stocksbridge No. 3); W. Yorks (Stanley No. 7); City of Wakefield (Belle Vue No. 1, Castleford No. 2, Eastmoor No. 2, Normanton No. 2, Primrose Hill No. 1); York No. 5.

West Midlands

Birmingham Nos. 159, 162, 530 and 531; Dudley No. 133 (Cradley); Lichfield No. 1; Nuneaton No. 14 (Bedworth Heath/Exhall West) and No. 15 (Chilvers Coton); Rugby No. 18; Stoke-on-Trent No. 31; Walsall No. 23 (Inner Broadway) and No. 24 (Pleck); N. Warwickshire No. 2; Warwick No. 4; Wolverhampton No. 20 (Wightwick); The Wrekin No. 1.

East Midlands

Amber Valley Nos. 1, 2 and 3; Blaby No. 9 (Braunstone and Leicester Forest East); Broxtowe No. 1 (Eastwood); Erewash No. 1 (Petersham, Long Eaton); Gedling No. 4; High Peak (Buxton No. 2) and (Glossop No. 8); N. Kesteven No. 1 (N. Hykeham and Skellingthorpe); S. Kesteven No. 2 (Grantham No. 24) and Nos. 3-7; Lincoln Nos. 11 and 12; Mansfield Nos. 2 and 3; Northampton Nos. 13 and 14; Nottingham No. 7A.

South Western

City of Bristol Nos. 12 and 14.

South Eastern

Brighton No. 2; Dartford Nos. 14 and 15; Epping Forest (Loughton No. 1); Gillingham No. 7; Luton No. 13; Milton Keynes No. 2 (Bletchley No. 5); Oxford No. 17; Slough No. 17; Spelthorne No. 13; Thurrock No. 12; Watford No. 14 (Paddock) and No. 15 (Central).

London Boroughs

Bexley No. 15; Bromley Nos. 25, 26 and 33; Enfield No. 20; Hillingdon Nos. 27-30; Kingston-upon-Thames No. 25; Merton No. 31; Newham No. 14; Waltham Forest Nos. 26-28.

NEW SMOKE CONTROL ORDERS CONFIRMED BUT NOT YET IN OPERATION

Northern

Allerdale No. 5 (Salterbeck Rd/Workington); Darlington No. 15 (Skerne Park); Langbaurgh No. 3 (Grangemouth North); Middlesbrough No. 24 (Town Centre West) and No. 25 Marton Road East; Stockton on Tees No. 6 (Cowpen Bewley Village) and No. 7 (Roseworth North).

North Western

Bolton No. 6 (Little Lever No. 5) and No. 7 (Westhaughton No. 12); Burnley No. 1; Ellesmere Port/Neston (No. 14); Hyndburn Nos. 36 and 37; St. Helens No. 11; Tameside (Dukinfield No. 19).

Yorkshire and Humberside

Barnsley No. 5 (Pilley) No. 6 (Worsbrough) and Nos. 7 and 8 (Thurnscoe); Calderdale No. 4 (Hedden Royd-Cragg Vale) and No. 22 (Halifax - Boothtown); Rotherham (Kilnhurst) and (Rawmarsh No. 7).

West Midlands

Birmingham Nos. 163 and 532; Rugby Nos. 19-21; E. Staffs. No. 6; Stoke-on-Trent No. 32; Walsall No. 25 (Shelfield); Wrekin No. 2.

East Midlands

Ashfield Nos. 3 and 4; Blaby No. 10 (Leicester Forest East and Kirby Muxloe); Broxtowe (Eastwood No. 2); N.E. Derbyshire No. 24 (Holmewood) and No. 25 (Clay Cross East); S. Derbyshire (Sinfin); Erewash No. 2 (Bennerley/Ilkeston); S. Kesteven No. 8 (Grantham No. 25) and No. 9 (Stamford No. 1); City of Lincoln No. 13.

East Anglia

Peterborough Nos. 4 and 5.

South Eastern

Bracknell No. 6 (Central); Portsmouth No. 3; Stevenage No. 4.

London Boroughs

Merton No. 33; Sutton No. 31; Waltham Forest Nos. 29 and 30.

NEW SMOKE CONTROL ORDERS SUBMITTED BUT NOT YET CONFIRMED

Northern

Allerdale No. 5 (Salterbeck Rd/Workington); Darlington No. 16 (Cockerton) and No. 17 (Haughton); Middlesbrough No. 24 (Town Centre West) No. 25 (Marton Rd East) No. 26 (Marton Grove) and No. 27 (Albert Park); Sedgefield (Newton Ayecliffe No. 7); Tameside (Dukinfield No. 19); N. Tyneside No. 1.

North Western

Bolton (Little Lever No. 5) and No. 7 (Westhoughton No. 12); Chorley No. 2 (Clayton Brook); Ellesmere Port/Neston (Area No. 14); Manchester (Monsall); Pendle (Barnolds-

SMOKE CONTROL AREAS

Progress Report

Position at 31st December 1976

(Figures supplied by the Department of the Environment, The Welsh Office, the Department of the Environment for Northern Ireland and the Scottish Development Department).

	England			Wales			Scotland			Northern Ireland		
Smoke Control Orders Confirmed prior to 30.6.76	4,689			21			251			68		
Acres		1,542,438			2,912			136,674			16,111	
Premises			6,779,083			10,499			573,573			43,266
Smoke Control Orders Confirmed (30.6.76-31.12.76)	51			—			1			4		
Acres		28,504			—			438			661	
Premises			84,891			—			2,127			4,243
Totals	**4,740**	**1,570,942**	**6,863,974**	**21**	**2,912**	**10,499**	**252**	**137,112**	**575,700**	**72**	**16,772**	**47,509**
Smoke Control Orders submitted (30.6.76-31.12.76)	74			3			1			1		
Acres		38,082			51			746			835	
Premises			119,332			255			1,820			535
Grand Totals	**4,814**	**1,609,024**	**6,983,306**	**24**	**2,963**	**10,754**	**253**	**137,858**	**577,520**	**73**	**17,607**	**48,044**
Smokeless Zones (Local Acts) in Operation ..	44			—			—			—		
Acres		3,400			—			—			—	
Premises			41,060			—			—			—

wick No. 1); Rochdale No. 4 (Norden and Bagslate Moor); Salford No. 15 (Worsley); Vale Royal No. 1 (Manchester Rd); Warrington No. 3 (Cutcheth/Glazebury); Wigan (Ashton-in-Makerfield No. 2 and Tyldesley No. 16).

Yorkshire and Humberside
Barnsley Nos. 1 and 2 (Upper and Lower Cudworth) No. 3 (Ardsley) No. 4 (Barnsley Barugh) No. 5 (Pilley) No. 6 (Worsbrough) and Nos. 7 and 8 (Thurnscoe); Calderdale No. 2 (Ripponden-Soyland / Rishworth / Barkisland/Krumlin) No. 2 (Ripponden-Rishworth) and No. 22 (Halifax-Boothtown); Sheffield No. 29 (Stannington); York No. 6.

West Midlands
Birmingham No. 532; Lichfield No. 2; Rugby Nos. 20 and 21; E. Staffs No. 6; Stoke-on-Trent No. 33; Walsall No. 25 (Shelfield); N. Warwickshire No. 3; Wrekin No. 2.

East Midlands
Amber Valley No. 4 (Whitemoor Belper) No. 5 (Alfreton Park/Alfreton) No. 6 (Bailey Brook/Heanor); Ashfield No. 4; Bolsover No. 1 (Pinxton/S. Normanton); Broxtowe (Eastwood No. 2); N.E. Derbyshire No. 24 (Holmewood) and No. 25 (Clay Cross East); S. Derbyshire (Sinfin); Erewash No. 2 (Bennerley/Ilkeston); S. Kesteven No. 8 (Grantham No. 25); City of Lincoln No. 13; Nottingham No. 8B.

East Anglia
Peterborough Nos. 4 and 5.

South Eastern
Dartford No. 16; Gillingham No. 9; Milton Keynes No. 3 (Bletchley No. 6); Portsmouth No. 3.

South Western
Cheltenham No. 8 (Charlton Park) and No. 9 (The Running Track).

London Boroughs
Kingston-upon-Thames No. 26; Lambeth Nos. 31-35; Merton No. 33; Sutton No. 31.

NORTHERN IRELAND

NEW SMOKE CONTROL ORDERS IN OPERATION
Castlereagh D.C. Nos. 2 and 3; Craigavon B.C. Nos. 5 and 6.

NEW SMOKE CONTROL ORDERS CONFIRMED BUT NOT YET IN OPERATION
Belfast C.C. No. 10 (Var.) and No. 13; Craigavon B.C. No. 4; Down D.C. No. 1.

NEW SMOKE CONTROL ORDER SUBMITTED BUT NOT YET CONFIRMED
Antrim D.C. No. 5.

SCOTLAND

NEW SMOKE CONTROL ORDERS IN OPERATION
City of Glasgow District (Partick East, Partick West and Park); Nithsdale District-Dumfries (Castledykes).

NEW SMOKE CONTROL ORDER CONFIRMED BUT NOT YET IN OPERATION
Hamilton District No. 5.

NEW SMOKE CONTROL ORDER SUBMITTED BUT NOT YET CONFIRMED
Renfrew District (Elderslie).

WALES

NEW SMOKE CONTROL ORDERS SUBMITTED BUT NOT YET CONFIRMED
Wrexham Maelor B.C. Nos. 3, 4 and 5.

SMOKE CONTROL ORDER WITHDRAWN

Yorkshire and Humberside
Calderdale No. 2 (Ripponden-Soyland / Rishworth / Barkisland / Krumlin). Submitted in August, withdrawn in October and smaller area (Ripponden-Rishworth) submitted in November.

BOOK REVIEWS

Analysis of Air Pollutants
Dr Peter O. Warner, Wiley Interscience 1976, pp 329. £11
This book sets out to cover a broad field involving a very wide range of techniques. This in itself presents a dilemma in that many readers will not be familiar with all the basic theory required and the author is faced with the choice of outlining the basic theory or omitting it. The author has made the first choice but this, of necessity, means that to keep the size of the book within reasonable bounds the theoretical outlines must be exceedingly brief. As a revision of the theory these outlines suffice but for those coming to it for the first time it is often too sketchy.

The first chapter deals with the origin and identification of particulate air pollutants and this is followed by chapters dealing with sources and measurements of both organic and inorganic air contaminants. Continuous automated methods of air analysis are then described followed by a section on the principles of air sampling. This chapter on air sampling is extremely well done but it may be advantageous to move it to earlier in the book. The final two chapters deal with instrument calibration and odour measurement.

In general, these topics are covered very well indeed but there are both technical and typesetting errors. The statement that oxygen and nitrogen absorb infra-red radiation (page 171) is incorrect as also is the assertion that the entropy of pure crystalline solids is unity (page 36). The inconsistent use of headings leads to errors in the running titles at the top of a number of pages (e.g. page 109). In terms of topics omitted it is surprising in view of its use in analysing particulates that spark source mass spectroscopy is omitted.

Overall this is an excellent book and Dr Warner is to be congratulated on achieving such a high standard. Both practitioner and student will derive benefit from it.

D. F. Ball
University of Salford

Town Planning and Pollution Control
Christopher Wood. Manchester University Press, 1976. Pp. 237. £7·95.
Mr Wood has produced a rather interesting documentation of U.K. environmental planning initiatives—and failing that—a compendium of opportunities for pollution avoidance through planning controls. Refreshingly free from the usual reams of exhortative rhetoric about the need to promote a safe and healthful environment, this book is probably the best and most complete general review of pollution issues and technically feasible planning responses. The book addresses, in an orderly fashion, general issues of pollution control through planning and then proceeds to lay the groundwork for the reader by describing the production-consumption-pollution cycle. This is followed by chapters on pollution control responsibilities vested in planning authorities, conflicts between planning mechanisms and the more problematic circumstances of pollution control as it is applied step-wise in the planning process is provided with interesting examples drawn from actual planning programmes as well as development control cases.

Probably the most significant messages to be found in this book are: (1) pollution control is feasible in the context of land use planning, (2) the function of pollution control through planning is not amenable to the application of universal formulae (what works in one community will probably not be transferable to another), (3) the potential for conflicts between environmental and other planning objectives is a real and significant constraint to the use of planning as a pollution control strategy, and (4) co-operation between planners and control authorities is critical to the success of pollution control and avoidance strategies.

There are several very good sections which address the need of the local planning authority to select and plan for local standards of environmental quality. This area is treated in an interesting fashion and could be considered a good piece, in its own right, on the subject of standards setting and implementation issues.

The chapter devoted to planning strategies does beg significant criticism for conclusions drawn by the author about pollution avoidance techniques. A case in point is a section on the concept of the airshed as a limiting factor. Mr Wood repeats the old proposition of density dispersion as a means of diluting density-aggravated air pollution emissions. In point of fact, the proposition of lowering densities to reduce ambient concentrations can be found to be counter-productive, especially in areas where dispersed development means lengthened commuting trips by motor vehicles on congested radial roadways, to cite one example. There is little substantive comment in this book about the contribution of motor vehicle fume to the ambient concentration of pollutants on an area-wide basis. Further, the conflicts between an environmental policy of dispersal and issues of providing public services to sprawling areas of urbanisation seems too substantial to warrant the recommendation of such an approach under most circumstances. For good reasons other than pure dogma the solution to pollution is, ultimately, not dilution.

On the whole, however, I would suggest that the serious student of planning as well as the planning practitioner should acquire this book. If there may be some weakness in the propositions with regard to planning strategy application, there are substantial strengths in the overall organisation of the book especially with regard to addressing the major issues which face planners engaged in the process of planning for the management of urban or urbanising areas. Mr Wood has attempted to relate to the reader the interplay of issues and circumstances which the environmental planner must contend with in practice. Much to his credit, he has succeeded in achieving his aims.

Robert O. Otto
Visiting Fellow
Science Policy Research Unit
University of Sussex

Clean Air—Law and Practice (4th Edition)
J. F. Garner and R. K. Crow. Shaw and Sons Ltd. 1976. 282 pages. £6
The 3rd edition of this work was published in 1969 (reviewed in Smokeless Air, Spring 1970). Since that time important new legislation affecting the control of air pollution has been introduced. The Control of Pollution Act 1974, Part IV, is included in this fourth edition, and the implications of both this Act and the Health and Safety at Work Act 1974 are considered. Reference is also made to the proposals in the 5th Report of the Royal Commission on Environmental Pollution concerning the future administration of air pollution control. Previous editions of 'Clean Air—Law and Practice' have included the texts of Ministry memoranda and circulars relating to the Clean Air Acts. With the publication of its 3rd edition, the book was becoming a fairly hefty compendium of reference and had this trend continued, a volume of deskbound proportions would have been produced in 1976. Instead, the texts of circulars etc have been omitted, to be replaced by appendices listing the number, date and title of relevant regulations, circulars and memoranda, and British Standards. The

original Appendix A, Statutes, has been kept complete, with the addition of extracts from the Control of Pollution Act 1974.

This is, in effect, a shortened and revised revision of a classic. The intention was to provide a handbook, a practical (and portable) guide, for environmental health officers in particular. This is clear exposition of acts, practices and terms, properly arranged for easy reference. There are separate chapters on control of smoke, grit and dust, on furnaces and chimneys and another on works within the jurisdiction of the Alkali Inspectorate. The authors are careful to mention occasions when environmental health officers might have a duty to control certain emissions within a registered works. The text throughout is concise and immensely readable. Chapter 7 on legal proceedings is uniquely valuable, containing excellent advice on the conduct of cases, presentation of evidence etc. The authors acknowledge that all 4,800 or so registered EHO's are not employed exclusively on atmospheric pollution control. But with this book as a tool, the conduct of one body of legislation at least becomes a simpler undertaking. For those who are not specialists, the two chapters on smoke control orders provide a short cut to familiarity with every phase of the implementation of smoke control areas.

'Clean Air—Law and Practice', 4th Edition, is available from the NSCA at £6·40 inclusive of postage and packing (see insert in this issue).

Who Pays for Clean Air?

D. Harrison, Jr. Ballinger Pub. Co. 167 pages. £7·70

The book is confined to Automotive Emission Control in the United States and has a mathematical bias by relating its findings or suggestions to formulae.

It makes it clear that the U.S. conception of emission control by treatment of the exhaust gases is expensive, the burden of which falls on all owners of such cars in the form of greater first cost, greater annual operating costs and diminished fuel economy as well as greater repair and maintenance costs. Attempts are made to relate these extra costs to various income groups, car age groups, and geographic areas, not that this seems to have any significance. It is estimated that the cost price per vehicle for emission control equipment has risen from \$10 in 1971/2 to \$265 in 1977/80 and will settle thereafter at \$176. This would appear to be somewhat speculative. Prominence is given also to the distribution of benefits by income groups and other notional spheres.

It is concluded that auto emission control in the U.S. will cost \$62 per household annually and the benefits aimed at will be a reduction by 81% of carbon monoxide, by 68% of photochemical oxidants and by 48% of oxides of nitrogen. It is perhaps fortunate that such controls and consequent costs are not considered necessary outside the U.S.A.

P. Draper

Twenty Years of Air Pollution Control

Manchester Area Council for Clean Air and Noise Control (Author & publisher). 1976. 64 pages. £1·00

Manchester, with the highest population density in the UK outside London, and absolutely the highest domestic coal consumption per sq. km. in 1969, had memorably filthy air twenty years ago. Descriptions given then of their home town by Mancunians could not ignore the lid of atmospheric pollution clamped firmly on the scene. It was the task of the councils in the Greater Manchester area to lift the lid and allow the sky to show itself clean again for the first time since the early 19th century. The means had been provided by the 1956 Clean Air Act, and the report is a record of its implementation and the accruing benefits in this North-West conurbation.

The achievements in the reduction of pollution from domestic sources up to the present day can be seen clearly from the tables showing premises and acres under smoke control, with the figures given as a percentage of the total to be covered. Salford's is the outstanding success, with 98·55% of premises covered in 99·14% of total acres. But several of the other councils, notably Trafford and Tameside, are making excellent progress in the number of premises made smokeless.

The Manchester Area Council for Clean Air and Noise Control was set up in 1974, following local government reorganisation, and composed of representatives from the ten MDCs in Greater Manchester County, together with the three adjoining boroughs of Macclesfield, Rossendale and Warrington. Both elected representatives and officers attend meetings of the council as do co-opted members from relevant public bodies. Among other functions, the Council carry out investigations and research into air pollution. Although sulphur dioxide continues to be a major cause for concern, particularly from industrial and commercial premises, the Council have recently instigated research into the potentially toxic, low concentration air pollutants—heavy metals in general, and lead in particular. Carbon monoxide from road vehicles is also surveyed. Since the 1960s smoke and sulphur dioxide measurements have been made in the area as part of the National Survey; a map shows the location of the monitoring sites. At the moment the Council is examining the possible institution of ambient air quality standards or targets, which would provide uniformity within the area and yardsticks against which progress and the need for action could be determined.

Representation on the Council from the Alkali & Clean Air Inspectorate ensures that current progress in the control of air pollution from the ninety-three scheduled works is known. A map shows the location within the Greater Manchester area of these registered processes; the last scheduling order was made in 1971, which included the di-isocyanates works (foamed polyurethane industry), of which the area has a major share.

One of the most interesting sections of this report deals with the effects of pollution control. Those effects on health, plant and insect life, buildings and weather which are generally acknowledged and assessed are all mentioned, but the inclusion of local observations makes them intriguing. The parks department have found that park seats need to be cleaned less often, pruning and hedge-cutting are no longer regarded as dirty jobs by the staff. A nurseryman in the South Manchester area has been able to resume growing white flowers for the first time since the 1930s. And for some the greatest achievement of all, the turf at Old Trafford is markedly improved!

The report concludes that while there have been great and significant reductions in levels of pollution from both domestic and industrial sources, these levels are still higher in the Council's area than in most other parts of the country. It will also be future policy (already begun) to monitor potentially harmful elements, particularly those in airborne dust, and ascertain whether they constitute a hazard to health. The marked decreases in fog, and significant improvements in both visibility must have enhanced inestimably the quality of life for those living and working round Manchester. The report should be read by Mancunians, so that the scope and achievements of the clean air campaign in their area can be appreciated, but it is also an excellently presented, comprehensive survey that will provide a pattern book for other authorities.

To obtain copies of the report (the price of one pound includes post and packing) send a postal order or cheque made payable to "The Manchester Area Council for Clean Air and Noise Control", to the Publicity Officer, Mr. K. Williams, M.E.H.O.A., Assistant Director, Environmental Health, Housing and Environmental Health Divsn, Abney Hall, Cheadle, Cheshire SK8 2PD.

Dictionary of Environmental Terms

Alan Gilpin. Routledge & Kegan Paul. 1976. 191 pages. £3·50

The author, an ex-member of the NSCA's Technical Committee, has compiled a lively and useful work of reference. There are some 900 terms, with the emphasis rather more on water and the environment in general than on air and air pollution. In fact, almost two-thirds of the terms in the 1976 NSCA Year Book's 'Glossary of Terms Relating to Air Pollution' are not used in Dr Gilpin's Dictionary, although some are referred to in the very full definitions made under different headings.

Dr Gilpin is not content with merely defining each term with a scientific description—he expands this in language suitable for both the layman and the specialist, and in many cases mentions specific examples illustrating his definition. The text is also brightened by several photographs and diagrams.

Every aspect of that study all too loosely called 'environmental' is included. A particularly careful analysis is made in respect of the balance of economics. Technical treatment methods are listed when a broad understanding of a general process can thus be gained. Meteorology and natural cycles are included where these have a direct bearing on pollution of the environment. Up to the date of publication, this work is fairly comprehensive. However, the very justification for its appearance, in that 'the environment' and studies related to it are vital current issues, will necessitate revision at regular intervals. In this edition, the horrid chlorofluorocarbons do not make an appearance; in a couple of years there will doubtless be many scientific discoveries and newly-defined pollutants to be included.

Lichens as Pollution Monitors

David L. Hawksworth and Francis Rose. Studies in Biology No. 66, Ed Institute of Biology. Edward Arnold Ltd. Sept. 1976. 59 pages. £2·80 Boards, £1·40 paperback

This publication reflects the authors' interest in studies of lichen species' distribution, but goes further in providing a detailed and convincing argument for the study of lichens as monitors of air pollution, and of SO_2 in particular. There have been books published earlier on the subject, notably the anthology 'Air Pollution and Lichens', edited by B. W. Ferry, M. S. Baddeley and D. L. Hawksworth, to which both the present authors contributed essays on mapping. But this new work is amply justified. It is short enough to absorb in a couple of evenings. The text is carefully arranged so that the density of information will not overwhelm a reader new to the subject. Clear line illustrations of lichen characteristics and species enhance the text, and two pages of black and white photographs identify some species used in air pollution surveys. As might be expected, several maps are drawn, but these appear only when the reader's interest and understanding have been aroused by the groundwork of earlier chapters.

The first chapter explains the symbiotic partnership between fungae and algae that constitutes the lichen thallus. The biology of lichens is described and a sound basis emerges for studying them in relation to the effects of air pollution. Chapter Two looks in detail at the relationship of SO_2 and lichens, showing the pollutant's effects in respect of lichen health, habitat and mechanisms of resistance. Chapter Three briefly surveys the effects of other pollutants. In Chapter Four the other factors affecting lichen distribution are considered. This is an essential balance to any air pollution survey, involving a range of Man's activities from wood and heathland management to building and farming practices, as well as natural factors such as topography and climate. Chapter Five covers the science and technique of mapping air pollution patterns using lichen distribution. The emphasis is on corticolous (tree-growing) species; standardisation procedures are facilitated by trees of the same species or similar bark characteristics, although man-made materials such as asbestos-cement are valuable when saxicolous (rock-growing) species are studied. Chapter Six assesses the results of mapping, describing the impact of SO_2 on the British lichen flora. Account is given of increasing and declining species, with analysis of species numbers. Chapter Seven briefly surveys other data on SO_2 and its effects upon diverse organisms. In addition to reviewing theoretical aspects of lichens as pollution indicators, this publication emphasises phenomena which can be seen easily in the field and describes some projects suitable for use in schools, colleges and degree courses. The comparatively low price of the booklet will enable most educational establishments to provide a valuable addition to their environmental studies library.

Man and Environment

Robert Arvill. Pelican, 1976 (4th Ed.) 432 pages. £1·25

The first edition of this book came out in 1967. Since then it has been revised and updated, and this latest edition contains new sections on noise (under 'Air over Britain') and on environmental impact statements and assessments, in an appendix. The book's popularity must surely rest on its comprehensive and factual treatment of the many topics under the general term 'environment'. The sub-title 'Crisis and strategy of choice' reflects the author's position as a serious-minded environmentalist. He is no unreasonable eco-extremist, but has practised planning for conservation at local, national and international levels. The very sensible policy adopted throughout the book is to discuss a topic in general terms, and then deal specifically with Britain's position.

The section dealing with air and air pollution is a thoroughly competent and well-balanced survey of the subject. Even this praise is less than fair, since it seems to indicate too dry and dull an approach: in fact the writer handles legislation, science and human involvement with a deftness and interest which secures the reader's involvement. Knowledge on the reader's part of the subject under discussion highlights the compactness of the writer's technique. Throughout his very broad field, Mr Arvill is not afraid to draw conclusions on the need for future policies, nor to outline what these should be.

It will be satisfying to all members of the Society to read in the 'appraisal' section on air that "much depends on the National Society for Clean Air—a powerful voluntary body which is working to abolish all forms of air pollution. It expects Britain to be smokeless within 10 to 15 years. The Society has achieved a great deal in the field of public education and has produced some excellent leaflets and reports on conference proceedings. There is now little excuse for any local authority which pleads ignorance or public apathy, and fails to put into effect the regulations at its disposal."

Environmental Health Report 1975

The Environmental Health Officers Association, September 1976. 66 pages. 60p.

The report acknowledges that both industry and local authorities have been affected by the depressed state of the national economy in their fight to control air pollution. Referring to Part IV of the Control of Pollution Act, under which industry may be required to provide more information about the nature and quantities of emissions, the report emphasises that there must be an obligation on both parties to ensure that the information is given to the public in terms which can be generally understood.

The proposal in the Fifth Report of the Royal Commission on Environmental Pollution that there should be ever increasing co-operation between those in the central and the local authorities responsible for air pollution control is welcomed. The report does not commit the EHA to an opinion about the recommendation that a new, unified central pollution inspectorate, HMPI, should be set up.

It is encouraging to see that this report considers that the development of a combined research project into odour control was one of the most significant events of 1975. This vindication of the NSCA's choice of subject for the Spring 1976 Technical Seminar is very welcome. And since almost half of the space devoted to pollution control in the report deals with noise, it seems likely that the 1977 NSCA Seminar on Noise will also be thoroughly successful, and of great interest to environmental health officers.

Corrigendum

The author of 'Waste Not, Want Not: Air', Anne-Marie Constant, is a Belgian national, and not a Canadian as stated in our review ('Clean Air' Autumn 1976, p. 22).

New additions to the NSCA Libary

Advisory Committee on Major Hazards. First Report. Health and Safety Commission, September 1976. 20 pages.

Alternative Energy Sources for the UK. Dr J. K. Dawson. Reprinted from ATOM, January 1976.

An Annotated Bibliography of Canadian Air Pollution Literature. Christopher J. Sparrow and Leslie T. Foster, Eds. Ann Arbor Science, 1976. 270 pages. £14·65.

Bothered by Noise? How the Law Can Help You. Noise Advisory Council and COI leaflet, 1975.

The Clean Air Campaign in England. Radio Denmark, 1976. 20 pages.

Clean Water and the Dairy Products Industry. US EPA, July 1976. 20 pages.

The Committee for Environmental Conservation (CoEnCo) Report for 1975—A Widening Horizon. 34 pages. £1·00.

Comprehensive Report—International Lecture Meeting on Environmental Quality Standards for Nitrogen Dioxide. Industrial Pollution Control Association of Japan, March 1976.

Department of the Environment Register of Research, 1976. Part IV, Environmental Pollution. DoE HQ Library, 1976. 255 pages.

Dictionary of Environmental Terms. Alan Gilpin. Routledge & Kegan Paul, 1976. 191 pages. £3·50.

Electricity's Balancing Act. Sir Arthur Hawkins. CEGB, 1976.

The Environmental Control Industry. A Report to the Council on Environmental Quality. Kenneth Ch'uan k'ai Leung and Jeffrey A. Klein. Ann Arbor Science, 1976. 138 pages. £9·95.

Environmental Health Report 1975. The Environmental Health Officers' Association, 1976. 66 pages. 60p.

Factors Affecting Automotive Fuel Economy. US EPA, Office of Air and Waste Management. 20 pages. May 1976.

The Field Testing of Dust Control. J. B. Auger. Reprinted from Verifact, Vol. 1, No. 6.

Future Research Goals for the CEGB. D. J. Littler. CEGB Newsletter No. 101, October 1976.

The Hopeful Captive Customer. Sir Arthur Hawkins. CECB, November 1976.

Inquiry into Pollution from Farm Waste: Reports. Advisory Council for Agriculture and Horticulture in England and Wales, 1976.

The Law and Practice Relating to Pollution Control in the United Kingdom. J. McLoughlin, for Environmental Resources Ltd. Graham & Trotman Ltd, 1976. 386 pages. £7·50. (Reference only).

Lichens as Pollution Monitors. David L. Hawksworth and Francis Rose. The Institute of Biology's Studies in Biology No. 66. Edward Arnold, 1976. 59 pages. £1·40.

Methods for the Detection of Toxic Substances in Air. Booklet No. 5. Nitrous Fumes. Health and Safety Executive. HMSO, 1976. 12 pages. 62p.

Nuclear Power and Public Policy. Sir Brian Flowers. Lecture given at the British Nuclear Energy Society, December 1976.

The Occurrence and Significance of Air Pollution by Photochemically-Produced Oxidant in the British Isles, 1972-1975. R. G. Derwent, G. McInnes, H. N. M. Stewart and M. L. Williams. WSL Report No. LR 227 (AP). WSL, 1976. 101 pages. £4·00.

Ozone Levels in Southern England, June 22-July 12, 1976. A. J. Apling, G. McInnes and M. L. Williams. WSL, 1976.

Pollution and Your Health. US EPA, May 1976. 16 pages.

A Practical Approach to Fan Engineering. J. B. Auger. Reprinted from Verifact, Vol. 3, No. 2, June 1976.

Published Regulatory Guidelines of Environmental Concern to the Oil Industry in Western Europe. Concawe Report, No. 6/76, October 1976.

Recommended Procedures for Handling Major Emergencies. Chemical Industry Safety and Health Council of the Chemical Industries Association. July 1976. 17 pages. £1·75.

Reflections of an Alkali Inspector. The 3rd Sir Hugh Beaver Memorial Lecture. F. E. Ireland. December 1976.

Renewable Sources of Energy and how far they might be made to meet Britain's Energy Needs—a Symposium. Royal Society of Arts. June 1976.

Residential Traffic Noise Control Using Tree-Shrub-Barrier Combinations. David I. Cook and David F. Van Haverbeke. Reprinted from 'Shelterbelts on the Great Plains'. Proc. Symp. (Denver, Colorado, April 1976). Great Plains Agricultural Council.

Royal Commission on Environmental Pollution. 6th Report—Nuclear Power and the Environment. HMSO, September 1976. 237 pages. £2·65.

Spillages from Oil Industry Cross-Country Pipelines in Western Europe. Statistical summary of reported incidents, 1975. Concawe Report, No. 7/76. November 1976.

Town Planning and Pollution Control. Christopher Wood. Manchester University Press, 1976. 237 pages. £7·95.

Twenty Years of Air Pollution Control. Manchester Area Council for Clean Air and Noise Control. December 1976. 64 pages. £1·00.

Who Pays for Clean Air? David Harrison Jr. Ballinger Pub. Co. (USA), 1975. 167 pages. £7·70.

INTERNATIONAL NEWS

ITALY

On 20th October last the Associazione Termotecnica Italiana, the Italian member of I.U.A.P.P.A. arranged a meeting for European members in Venice under the Chairmanship of Professor Carlo Padovani. Although it was originally expected that only representatives from Europe would attend, in fact representatives from the Argentine, France, Germany, Italy, Yugoslavia, Switzerland and the United Kingdom attended. Discussions took place about the proposed new statute for I.U.A.P.P.A. and a number of minor amendments were suggested for discussion at the forthcoming I.U.A.P.P.A. meetings to be held in Tokyo in May 1977 in conjunction with the 4th International Clean Air Congress.

On the 22nd October, an open meeting was held in Venice which was attended by a number of industrialists at which the representatives from Italy, Germany, France and the United Kingdom presented the philosophy of air pollution control in their own countries. Although there were naturally basic differences, it became surprisingly clear during the discussions which followed that the two differing schools of thought of the best practicable means on the one hand, and air quality standards on the other, are not so far apart as might at first be imagined.

JAPAN

The 4th International Clean Air Congress will be held at the Tokyo Prince Hotel, Shiba Park, Minato-Ku, Tokyo from Monday, 16th May to Friday, 20th May, 1977. The Congress will be sponsored by the International Union of Air Pollution Prevention Associations and will be hosted by the Japanese Union of Air Pollution Prevention Associations. The Congress Chairman will be Mr. Buzayemon Shindo, the President of I.U.A.P.P.A. and of J.U.A.P.P.A. Those wishing to participate in the Congress should complete an application form and send it with the participation fee to reach the I.U.A.P.P.A. Secretariat, P.O. Box 5457, Tokyo International, Tokyo 100-31, Japan to arrive not later than 21st April, 1977. The Congress fee is 50,000 Yen. The fee for speakers and co-speakers is 25,000 Yen. A very full programme has been arranged and in all, some 300 papers will be presented. Further details may be obtained from: I.U.A.P.P.A., of which the mailing address is P.O. Box 5457, Tokyo International, Tokyo 100-31, Japan. Meetings of the I.U.A.P.P.A. Council and Executive Committee will be held during the course of the Congress.

HUNGARY

Since the carbon dioxide level in Budapest was found to be three times the accepted tolerance level, the City Council have ordered new regulations requiring that air pollution in the inner city, caused by heating, must be eradicated by October 1985. Surrounding areas have been given until October 1999 to convert to fuel containing less than 1% sulphur.

FRANCE

France's oil research agency. Institut Francais de Petrole and the Government-owned Electricité de France have built a demonstration installation near Paris for testing its stack gas desulphurisation process. The aim is to prevent any pollutant discharge during the combustion of crude-oil or coal residues in factories and to recover sulphur in a form that can be easily stored and which is non-polluting.

HONG KONG

Taxis in Hong Kong are to be fitted with a new device which, it is claimed, not only reduces petrol costs by 25% and diesel costs by 10%, but also significantly reduces air pollution and prolongs engine life. Measured amounts of water vapour are injected into the combustion chamber, increasing efficiency and reducing fuel consumption.

Index to 'Clean Air'

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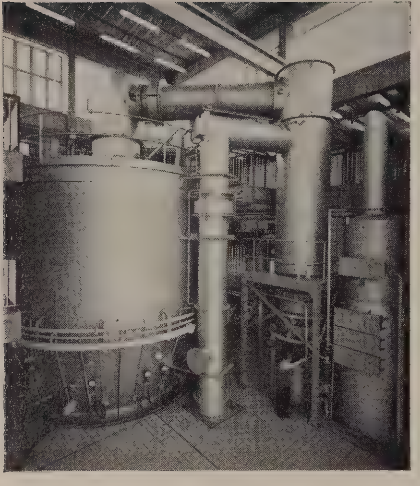
INDUSTRIAL NEWS



Esher Water Pollution Control Works

The Thames Water Authority (Southern Division) have been operating their sewage sludge incineration plant at Esher, Surrey, since June 1976. The system incorporates duplication of all principal ancillary equipment and economically makes use of recirculated sewage effluent from the water pollution control works for water requirements. The present sewage treatment works is designed to serve a population of 70,560 with a DWF of 16,380 m^3/day.

The flexibility of the Dorr-Oliver FluoSolids system, the first in the UK, has already been shown following shut-down for weekends and remedial action of minor teething troubles. After periods of shut-down the time required to reheat is relatively short due to minimal heat losses from the refractory-lined shell, and the heat reservoir of the sand bed. Unlike most other types of incinerators the plant can be shut down instantly without harm or the need to provide quench water or maintain cooling air. There are no moving parts within the reactor.

Sludge is handled from several sewage works in the area. The independent analysis of the stack emission has indicated that the performance of the plant has far exceeded the standard set in the specification. Initial evaluation of the running costs indicate that they are considerably lower than those predicted in a technical paper. After a suitable period of operation it will be possible to publish these details.

The reactor of the FluoSolids system is approximately 5 m diameter by 10%35 m overall height and consists of three sections: (1) the windbox or lower section beneath the constriction plate, (2) the fluid bed immediately above the constriction plate, and (3) the freeboard, the uppermost section, where solids are disengaged from the upward moving gas stream. The fluid bed is a mixture of sand and gases in suspension and provides the ideal environment for thermal oxidation of the sewage sludge. The Coil-filter cake introduced into the reactor is thoroughly and quickly mixed within the hot sand bed enabling the water content of the cake to evaporate whilst the organic content of the sludge reacts with the oxygen in the fluidising air thus providing complete combustion with minimum of excess oxygen at minimum temperature. The cold fluidising air from the blower passes through the gas to gas heat exchangers and is raised to a temperature of approximately 500°C by extracting some of the sensible heat in the reactor exit gases. The temperature of the exit gases leaving the freeboard of the reactor are controlled by means of a sonic spray system, thus giving protection to the heat exchanger.

The exit gases from the reactor pass down through the tubes in the heat exchanger and then into a venturi scrubber followed by a multi-tray cooling system. Hot gas is cooled to its adiabatic saturation temperature, and solids particulate matter is transferred from the gas stream to the liquid scrubbing stream in the venturi section. The saturated gas rises to the multi-tray cooling section of the scrubber where provision for alkali addition is made for maximum SO_2 removal. Water droplets containing particulate solids are removed from the gas stream in a vane separator. The scrubber water is recycled with automatic make-up using final effluent and as the ash content builds up in the system, scrubber water with approximately 2% ash is pumped to lagoons where very rapid settlement takes place leaving a bed of inert ash. The final stack gas emits through a relatively short chimney and normally a small white plume is emitted although, if required, a re-heat burner can be used for complete plume suppression. For initial starting the reactor from cold a pre-heat burner system is locally controlled in the basement and the burner functions within the windbox below the restriction plate. Once the reactor has reached an operating temperature of 620°C, oil can be injected into the fluid bed where self-ignition occurs. When the reactor reaches optimum temperature of 670°C, sludge is fed into the reactor and self-ignition takes place. The heat balance is maintained by controlling the quantity of oil which is fed into the bed. An oxygen analyser is placed in the exhaust gas system and excess oxygen is maintained at 5-10% by variation of the damper on the fluidising air supply. The control room complete with TV monitoring system provides central operation and fail safe interlock systems.

Reader Enquiry Service No. **775**

80% Waste Heat Reclaimed

The wastage of heat and the uneconomical use of heat energy is fast becoming a national problem. In many cases the heat exchangers, with a claimed 80% thermal efficiency, of the Westbury company, Curwen & Newberry Ltd, are helping to curb this wastage. The company have for some years been developing and marketing a wide range of heat regenerators. The rising cost of power and the need to conserve energy has broadened the company's markets both at home and abroad.

Photograph shows final assembly of an SW60A exchanger being fitted with its ESR2 gearmotor manufactured by Electropower Gears Limited of Aylesbury. The geared reduction is a ratio of 71·25:1, it is fitted to the 1 hp D80 frame metric motor via a powder coupling which compensates for a light load start and protects against overload. It is one of two types available, the alternative being the fluid coupling. The 'CN Heat Regenerator' is made in a wide range of sizes with duties from 250 to approximately 100,000 cfm. Types are available for applications with temperatures up to 1,800°F (980°C). Cross contamination is prevented by special purge equipment and the 'CN Heat Regenerator' is approved for use in hospital ventilation schemes. The regenerator can also be used in conjunction with air-conditioning systems where outgoing cool air can pre-cool incoming warm air, which is a reverse cycle.

Heat regenerators are constructed of an assembly of sector-shaped sections, which form part of the rotor or wheel. Each sector is filled with knitted wire or other material depending on the application. The removable rotor, when mounted in its frame, is driven on its central axis by the EPG gearmotor. This presents the sectors in rotation from the hot exhaust stream to the incoming cold air-

stream. The exhaust and fresh air-streams are ducted on a counterflow principle through the regenerator. As the hot exhaust air flows through the knitted mesh, which acts as the heat transfer media, heat is picked up and then transferred to the cooler fresh air-stream. The now heated warm air is circulated to the offices, factories or recycled back to the original process.

Reader Enquiry Service No. **776**

Gas Cleaning Plant Under Construction at BSC

Head Wrightson Process Engineering Ltd are constructing at the British Steel Corporation's Lackenby Works a £3 m secondary gas cleaning and fume collection system for the three furnaces at the BOS Plant.

The contract which was received from Davy Ashmore International Ltd is for equipment to collect the fumes which escape from the mouth of the furnaces during charging with molten iron and later during teeming of steel into open ladles. Hoods are being positioned in locations over the furnaces determined by two years of design and research work by Head Wrightson and BSC involving models of the unit and tests to finalise design.

A further extraction system provides roof hoods to collect fumes which rise to the top of the building after charging operations to and from the ladles. Both roof and furnace hoods are linked, with the gases being drawn through a 9 ft diameter duct leading to a wet scrubber cleaning plant outside the steelmaking plant building. The cleaned air is then driven by fans into three 120 ft high exhaust stacks for return to the atmosphere.

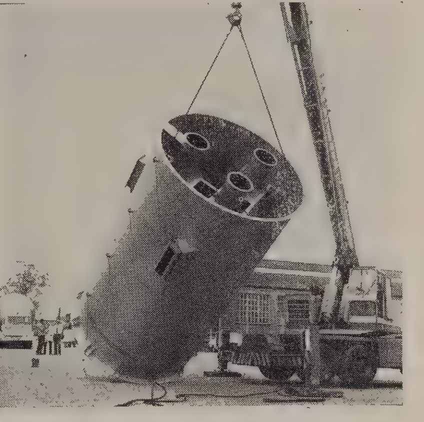
A cleaning system is also being installed to handle the other emissions of fume from the torpedo cars which carry the molten iron from the blast furnace to the steelmaking furnace charging ladles. Hoods are being provided over the hot metal pits and a 6 ft diameter fume main will lead to another wet scrubbing plant, cleaning the gas for release to the atmosphere from another stack.

The new extractive system on the first furnace is planned to come into operation during December this year. The remaining two furnaces will then be shut down in turn for conversion and it is planned to complete work by the end of 1977.

Reader Enquiry Service No. **777**

New Aid Against Pollution

The first commercial use of a newly-developed chimney which promises to yield considerable environmental advantages has been undertaken at the Reading factory of Gillette Industries. The purpose of the steel chimney is to reduce atmospheric pollution from oil-fired plant, and it achieves this by means of grit-arresting cyclones set in the base of a multi-flue chimney. Its base contains three cyclones which trap all the smut that would otherwise have been emitted. These cyclones can be speedily cleaned and serviced at regular intervals. Called the G.S.C. (Gas Solids Collector), the new chimney is being marketed by F. E. Beaumont Ltd. Experimental and field trial units have been tested by BP, but the Gillette chimney is the first to go into commercial use.



Reader Enquiry Service No. **778**

Arc Furnace Fume Handling

Fume control equipment to handle the fumes generated by two $4\frac{1}{4}$ ton electric arc furnaces has recently been installed at the Openshaw, Manchester Steelworks of Edgar Allen Balfour

CLEAN AIR

READER ENQUIRY SERVICE

FOR MORE INFORMATION and catalogues relating to items in this issue insert the reference number appearing below each item and post to National Society for Clean Air, 136 North Street, Brighton BN11 1RG

(Registered Office - Registered in England 594680)

REFERENCE NUMBER	RE/	RE/	RE/	RE/
RE	RE/	RE/	RE/	RE/
RE/	RE/	RE/	RE/	RE/

and the unnumbered item(s) on page(s) dealing with

PLEASE SEE THAT YOUR FULL NAME AND ADDRESS IS ENTERED BELOW IN CAPITALS

NAME OF FIRM

ATTENTION OF

ADDRESS

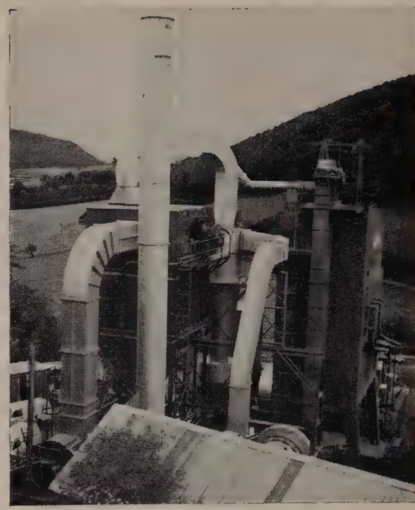
NATURE OF BUSINESS

Steels Ltd. The equipment, designed and manufactured by Midac Dust Control, comprises two extract hoods, extract ductwork, a mechanically shaken fabric filter unit, fan sets, screw conveyors and the associated steelwork. The mobile extract hoods are designed to run on twin rail tracks and are constructed of mild steel plate and fitted with fan assisted air curtain to ensure optimum fume collection efficiency. Fumes collected by these hoods—one of which serves each furnace—are ducted to a common fabric filter unit. The filter unit employed in the scheme is a Midac Type HT3 fabric sleeve filter unit which is capable of handling an air volume of 44,000 cfm with an air cloth ratio of 2·38 to 1. The unit comprises four separate compartments and has overall dimensions of 38 ft long, 19 ft wide and 7ft high. The filter unit is fitted with mechanical shaking gear which is designed to give automatic shakedown of each compartment whilst the filter unit as a whole remains in continuous operation. The filter unit was supplied complete with a control panel incorporating the necessary electrical control gear to give automatic sequential operation. For maintenance purposes the filter unit is provided with access ladders and galleries around its perimeter at two levels. Air movement through the filter unit is achieved by the backward bladed centrifugal fan which is designed to handle the system's volume of 44,000 cfm, the fan being driven by a 150 hp totally enclosed fan cooled motor. Four 10 in diameter, 10 ft long screw conveyors transport the collected fume dust from the hoppers of the filter unit. Cleaned air is exhausted to atmosphere through an exhaust stack manufactured from 14 gauge mild steel plate and which rise to a height of approximately 55 ft above ground level.

Reader Enquiry Service No. **779**

Nailsea Move to Metric

Nailsea Engineering are currently "going metric" and all future filters will conform to metric standards. In making this change, Nailsea have also taken the opportunity to increase the size of the bags used, yielding an additional surface area of 50%: this allows for fewer bags to be used with a substantial reduction in the overall size of the filters. There is a consequent cost benefit which goes a long way to combating the effects of inflation. The increased bag size has been made possible because the venturi nozzles on the reverse jets (introduced last year) have improved the efficiency of the bag-cleaning to the necessary extent. Nailsea emphasise that although future installations will be metric, replacements will remain available for all non-metric filters currently in use.



Reader Enquiry Service No. **7710**

After many years as Chief Engineer at Millars Machinery Company, Mr Steve Kedick has launched his own company under the name of Oxbow Engineers Ltd in Bishop's Stortford, Herts. Activities will be largely in the field of materials handling equipment. The new company has been appointed to represent Nailsea Engineering Co Ltd throughout the South of England. Mr Kedick is already a well-known figure throughout the quarrying industry, where Nailsea equipment has wide applications.

NATIONAL SOCIETY FOR CLEAN AIR

Annual General Meeting

2 p.m. WEDNESDAY, 6th July 1977

C.E.G.B. LECTURE THEATRE

Sudbury House, Newgate Street, London E.C.1.

3 p.m. Annual Public Meeting

The President will present his inaugural address

Printed in England by The Press at Coombelands Ltd., Addlestone, Surrey.

CLEAN AIR

SUMMER 1977
VOL. 7 NO. 25

Smoke Control Orders

News from the Divisions

International News

Reflections of an Alkali Inspector
F. E. Ireland

The Manchester Seminar

Noise Section

Industrial News

Book Reviews

Pollution Abstracts

CLEAN AIR

THE JOURNAL OF THE NATIONAL SOCIETY FOR CLEAN AIR

Vol. 7 No. 25 **Summer 1977**

The Conference

The Clean Air Conference this year will be held in Harrogate from Monday, 19th, to Thursday, 22nd September, a month earlier than usual. The Conference is also one day shorter than in the past and will end at midday on the Thursday. Nevertheless, there will still be six working sessions as the Wednesday afternoon, often used in the past for visits and other activities, will be taken up by a working session. There will, however, still be technical and social visits and a golf tournament on the Thursday afternoon. There will also be at least one technical visit on the Monday afternoon. These changes have been made as a matter of deliberate policy in an endeavour to reduce the overall cost for delegates attending the Conference, an important consideration in these days of financial stringency. It is sincerely hoped that the changes made will encourage more people to attend the Conference than in recent years.

Achieving the right balance for a Conference programme is by no means an easy task: it is not possible to please all the delegates all the time. Sometimes a programme can be too technical; sometimes it can be not technical enough. Some programmes will be to the liking of representatives from industry; other programmes will not please industry but will be welcomed by representatives from local authorities. And although delegates are not slow to state their dislikes, they tend to be rather more reluctant to make definite proposals about the content of future programmes. Bearing all these things in mind, a programme which deals with the essential philosophy of clean air has been arranged. On the Monday evening there will be a review of progress, and on the Tuesday morning Conference will debate the need for clean air. On the Tuesday afternoon, what has been achieved and what still remains to be done will be examined. This will lead in to the session on Wednesday morning when the question of legislation and control will be considered against the background of the environmental programme of the EEC, a programme which could have more far-reaching effects on our legislation than is always realised. On the Wednesday afternoon the effects of pollution on agriculture and forestry will be presented by speakers who are actively engaged in research in this field in which there have recently been a number of new discoveries. This is a subject to which more attention will have to be paid in future. The last session on the Thursday morning will deal with nuclear power and the environment. This Society has long advocated a fuel policy: now the time has come when the members of the Society must decide for themselves where they stand with regard to the development of the use of nuclear energy. The current debate about this is often emotive, and many of the people engaged in it are not always well informed about this very complex subject. What is said Thursday morning will not in any way settle the argument; but it will provide delegates with essential information about a highly important and controversial matter.

Such a programme deserves a good attendance. It is realised, however, that even with a shorter Conference, it is not possible for some delegates to be present the whole time. Further, some subjects will interest some people and not others. Special arrangements have therefore been made for sessional registrations at appropriate rates for those who cannot be at Harrogate for the whole time.

We hope to see you in Harrogate.

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Cover: North Road Station Museum. Original passenger station on the Darlington & Stockton Railway, recently restored and converted to a railway museum to commemorate the 150th Anniversary of the first passenger steam train service in the world. Courtesy Darlington B.C.

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The Third Sir Hugh Beaver Memorial Lecture

REFLECTIONS OF AN ALKALI INSPECTOR

by

F. E. Ireland

H.M. Chief Alkali and Clean Air Inspector

I am privileged to have known Sir Hugh Beaver. He was a legend within his own lifetime for the part he played in air pollution control following the tragic smog of 1952. A Committee on Air Pollution was formed with Sir Hugh Beaver as Chairman, and, after its work was completed and the Report submitted, he lectured in many parts of the country. In 1953, I had been appointed as the Alkali Inspector in charge of the district based on Sheffield and I was introduced to him when he came to lecture at a nearby town. It was a brilliant lecture, given with authority, but my lasting impression is of the man himself. He was a giant amongst men and he was recognised as such.

The Government accepted the basic recommendations of the "Beaver" Committee by passing the Clean Air Act in 1956 and there were two important consequences. The first was the setting up of the Clean Air Council with the then Minister of Housing and Local Government (Mr Henry Brooke—now Lord Brooke of Cumnor) as Chairman. It was natural for Sir Hugh Beaver to be appointed to the Council and it held its first meeting on 11 July 1957. The second event in 1958 was important for me because I was promoted to Deputy Chief Alkali Inspector in London, when the Inspectorate and its range of duties were vastly expanded as a result of recommendations made by the "Beaver" Committee. These two events were the link which brought us together occasionally. At first I deputised sometimes for my Chief Inspector on the Clean Air Council, but later I sat in my own right when I was promoted to that office in 1964. Whenever Beaver spoke, his colleagues listened most carefully, and it was obvious that the Minister looked to him for authoritative guidance. Those were formative days for the Clean Air Council and its first and most important task was to advise the Minister on the drive towards smoke prevention from industrial furnaces and domestic fires. Beaver helped enormously.

Regrettably, he had to resign from the Clean Air Council at its 28th meeting on the 28 October 1966 because of failing health and he died shortly afterwards at the age of 77. The Minister paid a tribute to Sir Hugh Beaver at the 29th meeting on 10 February 1967. We had all lost a friend and mentor.

The "Beaver" Committee recognised that smoke was perhaps the most important of the air pollutants contributing to ill-health, dinginess and smog formation. It was not the only pollutant whose concentration in the atmosphere had to be reduced to improve the quality of life, but it seemed to be the most amenable to control. In the Second Memorial Lecture, Lord Ashby reminded us that the campaign against smoke, and for a Clean Air Act, began about 150 years ago. I want to take you back just over 100 years when another great personality, the first Chief Alkali Inspector, Dr Angus Smith, FRS, also campaigned against pollution of the air. His statutory interests did not include smoke, but it did not take him long to recognise it as a major evil. When he was appointed in 1863, he was already an accepted authority on the composition of rain and the atmosphere, and it is interesting to look back and compare Smith's work with the re-discoveries of today.

It may be remembered that the purpose of the first Alkali Act of 1863 was to control the emission of hydrochloric acid gas (or muriatic acid gas as it was then known) from the first stage of the Leblanc process for making alkali. It was not until the Alkali Act of 1881 that other processes were added to the Inspectorate's range of duties. Meantime, Angus Smith, with his active and probing mind, was soon advising on problems outside the alkali industry. In his Annual Report for 1866 he wrote "At present the Alkali Inspectorate are brought into contact with various chemical manufactures which they do not inspect. It is, however, impossible for them to be quite regardless, or, at all times, quite silent. To give an example, there is a description of an outburst of gas at Messrs Johnsons' works at Runcorn. When I received the complaint I was at Newcastle and could not attend, but I telegraphed to Mr Fletcher, who, it will be seen, found both muriatic and sulphuric acid escaping in a confused way. He arranged for a mode of preventing both."

"It is from such occurrences, of which I only give examples, that we are driven to perform a little amateur inspection of gases other than muriatic."

In those early days of the Alkali Inspectorate, the headquarters of the Chief Inspector were in Manchester, where Smith had his laboratory opposite All Saints' Church, about a mile from the Exchange, or centre. It was natural, therefore, for him to conduct a lot of his experimental work on rain and the composition of air in Manchester and the surrounding area. In his second Report he wrote, "I showed some years ago that the rain water of great coal-burning towns is very acid, and that about a thousand tons of vitriol are showered down

on Manchester yearly."

In his third Annual Report, Smith began the long series of reports of his analyses of products of combustion, air and rain, and the effect of pollutants on vegetation. For comparison, he not only sampled the air in remote places in Britain, such as the Outer Hebrides, but he sought similar information from the Continent of Europe. His 1866 Report contained notes on the "Basis for Defining a Nuisance", in which he said: "We shall never arrive at an exact definition of a nuisance, but we may approach nearer to it constantly. It seems to me we have a basis to begin with in the smoke of the coal which we so freely use. We cannot free ourselves at present from the acid gas which accompanies it more or less, caused by the combustion of the sulphur."

He went on to compare the quantity of sulphurous acid, emitted from the burning of coal, with the hydrochloric acid from alkali works, and concluded that "the amount of acid is greater than the amount sent out by alkali works per cubic foot." In this same report when commenting on the analyses of waste products of combustion, he was concerned at the poor combustion despite large quantities of excess air being present. He put this down to poor mixing of air and fuel and added, "Mr Prideaux says well ' that all the air which passes through a furnace without giving up its oxygen to the fuel serves only to abstract heat, without yielding any in return.' The amount of air which from domestic fires is sent up the chimneys is estimated at 20 times more than is needful for combustion, abstracting heat and doing very little good. We suppose that it ventilates the rooms . . ."

Here we have Angus Smith describing principles of combustion that we only really began to appreciate and apply a 100 years later. His themes of reduction of excess air and good mixing in the combustion chamber are developed even more in his 1868 Report, where he also discusses the injection of steam. "There is a mode of consuming smoke which consists in simply blowing into the furnace a jet of steam. The effect is instantaneous and remarkable. A clear flame is produced in a few seconds. This circumstance has probably induced many persons to attempt to burn steam." Smith went on to explain this phenomenon as the decomposition of the steam by hot carbon into hydrogen and carbon monoxide, which subsequently burnt, but he also appreciated the better mixing of gases.

In this fifth Report for 1868, Smith reported in detail the results of his examination of rain in 1851 and in 1857 and compared them with analyses of rain in Paris and Nantes. He not only gave analyses for sulphuric and hydrochloric acids, but also analysed for ammonia, sulphates of ammonia and alkaline and earth salts, along with organic matter. He distinguished between ammonia derived from man-made sources, such as the burning of coal, and ammonia from natural sources, which he called "albuminoid" ammonia. Just 100 years later, in the Annual Alkali Report for 1968, I commented on the work of an investigating team from the United Kingdom Atomic Energy Authority, Harwell, in collaboration with the Warren Spring Laboratory and local Tees-side bodies, who investigated the composition of Tees-side mists. Ammonium compounds, we learnt, seemed to play an important part in mist stabilisation, but the quantity of naturally-occurring ammonium compounds in the air over this country was tending to confuse the assessment of the effect of man-made contributions. In fact, the team found that concentrations of ammonium compounds in the air of relatively rural Harwell, were comparable with the average concentrations on Tees-side, although there were many known sources of industrial ammoniacal emissions at the latter area.

There is currently a great interest in the transport of pollution over comparatively long distances and a great international research investigation is taking place under the auspices of the Organisation for Economic Co-operation and Development. A major interest is the transport and atmospheric chemistry of oxides of sulphur, especially in connection with their effect on the forests, rivers and lakes of Scandinavia. It is now being shown that the sulphur exists predominantly in the form of sulphates which are being washed out of the air by rain, and the resultant acidity is said to be killing fish and vegetation in rivers and lakes. Pressure is being put on the UK and other European industrial countries to reduce emissions of sulphur oxides by using low sulphur fuels, or by desulphurisation of flue gases. Attention is also being focussed on the part played by sulphates as major environmental polluters in a broad sense. There is still a good deal of speculation about the importance of sulphates and nations are naturally looking for more facts before being committed to spending large amounts of scarce finance on corrective measures. The cost to the UK alone would probably run into hundreds, if not thousands, of millions of pounds to desulphurise, with the corresponding benefit doubtful. The investigation continues.

In those early Reports, Angus Smith discussed the formation of sulphates in the air and gave the results of his analyses. He philosophised about nuisances, ozone and the reasons for examining air, but his great belief was in chemical analysis for fact finding. He opened his ninth Annual Report in 1872 as follows:

"In former years when I reported on the escape of muriatic acid from alkali works, being rather weary of the monotony as well as of the narrowness of the subject, I commenced enquiries into the amount of other gases, so as to give an idea of the extent to which the air of our towns is injured by manufactures. I have also thought it to be a proper use of my time to include researches into the amount of organic and inorganic substances existing in the atmosphere in populous towns and in country places. The intention was to establish a method by which we could judge definitely of the condition of a place as to general health, from the result of chemical experiment, without waiting for the evidence in the disease or death of human beings." This is entirely a new inquiry; at least it is new to have any steady sucess in the matter; and it is of great importance that such experiments as I made should be continued, and so rendered available for regulating our opinions both of the health of individual places, and the effect of individual causes.

"I have thus extended my work from that of the inspection of alkali works to the examination of air generally for sanitary purposes, so far as chemical means are concerned; and I hold that it is of great importance that a chemical branch for such inquiry should exist, and in doing so said, I consider myself to be acting in the spirit in which the Alkali Act was conceived.

"Another branch to which I have devoted myself in the reports given in has been the climatological, bringing a chemical agency into that department also, a little more decidedly than has ever been attempted, making a foundation for future efforts.

"The argument may be summed up in this:- we require the introduction of more chemical investigation into the Sanitary and Meteorological Departments." What an explorer and a prophet was Angus Smith! When we examine what we are doing today in the way of sampling and analysing the atmosphere and rain, the work of the Warren Spring Laboratory, the Meteorological Office, the Universities, and many other organisations, we can appreciate how true were his words and what a pioneer he was. Public awareness of air pollution problems is greater today than ever before. Concentrations of air pollutants too small to cause acute clinical symptoms may cause long-term injury in humans and animals, aggravate existing weaknesses and severely affect the growth of plants. The search for reliable methods of analysis is not new, as we have seen, but the great difference between Smith's era and ours is in the big advance made in scientific measurements. His available weapons were long sampling periods, with the samples having to be transferred back to the laboratory for macro analysis. Today, in addition to the National Survey techniques, we have available such esoteric methods as non-dispersive infra-red measurements, flame ionisation analysis, gas chromatography linked to a mass spectrometer, pulsed fluorescence, detection by electron capture, and many adaptations. Remote sensing by ultra-violet light and laser beams is also being practised. Smith was one of the early pioneers pleading for scientific measurement to replace guesswork.

We often read today of the success of the Clean Air Acts, pioneered by Beaver, in terms of improved public health and amenity, increased winter sunshine, better visibility and the appearance of flora and fauna where they would not flourish before. In London for instance, since 1956 there is said to be 70 per cent more winter sunshine, and average visibility has increased from 1½ miles to 4½ miles.

Let us look back to 1880. In this Report, Smith devoted several pages to the "Measurement of Sunshine for a Year" and "Transparency of Air in Town and Country". He attributed the method of measurement to Dr Albert R. Leeds, U.S. It consisted in the liberation of iodine from a solution exposed to the light, or actinic power of the sun, and gave a result which could be analysed and stated in figures. He said "The reason for making an inquiry into the total light arose from a conviction that all South Lancashire was suffering in vegetation, and that the towns were in the same way rendered inferior in atmosphere, partly from the want of light, although to some extent from the acid of smoke. The black carbon as an agent of darkness is not to be slighted." He took measurements at three places in Manchester. (1) All Saints' Church; (2) Rusholme, about a mile and a half further south, and (3) Didsbury, about five miles from the Exchange. He commented, "It is to be remarked, however, as I am told on good authority, that no violets will grow nearer to Manchester than Didsbury. This is objected to by a gentleman who lives a mile or more nearer. The reply, however, from a competent authority is that these latter are not healthy, and are always infested by a small red spider. The violet becomes thus a very delicate test for air." True enough the figures for Didsbury were much higher than those for All Saints' Church, with those for Rusholme intermediate. He appreciated that the results only gave an empiric measure of the total light. Today, suitably sensitive plants are used as indicators of atmospheric pollutants.

Black Smoke

Dr Angus Smith wrote frequently about smoke, its damaging effects and its prevention. To him, smoke was all the products of combustion of fuel, including particulate matter which he referred to as black smoke, and gaseous matter. In his earlier Reports he seemed more concerned with the gaseous acidic constituents, but gradually he began to appreciate the hazardous and objectionable nature of black smoke and campaigned for the greater use of smokeless fuels, that is, coke. We must remember that he had not come up against the problems of firing with liquid fuels except, in a small way, those derived as a by-product from coal carbonisation. Nonetheless, he remarked on the acidity of soot, which we still live with today mainly as a not-completely solved problem from the burning of sulphur-containing fuel oil.

By 1880, smoke was a major theme of Smith's and he wrote in a way which we can well recognise today. Concerning vegetation effects and their amelioration he said, "Black smoke contains a spongy charcoal, which wherever found is full of acid. This carbon if burnt would allow the sulphurous acid to pass off as already explained.

"In two reports attention has been called to the mode of using coal by distilling it first and then obtaining, instead as now of destroying, the products of distillation, and making them a nuisance to ourselves." Smith continually tried to get British coke makers interested in the process of by-product recovery, which he had seen at Bességes, as compared with the conventional beehive coke ovens used in Britain, which wasted valuable products of distillation by using them to heat the coal. He says "The present method of making coke in England has all the appearance of roughness and savagery which extravagance always produces."

Indeed, coke ovens are still a major air pollution problem on a global scale, despite by-product recovery being used universally. The major emission problems of modern coke ovens can be stated briefly as (a) "green" gas during the charging of coal; (b) smoke and particulates during the discharging and quenching of coke, and (c) leakages of raw gas from doors and lids. In the last decade, major developments have been tried and are now being brought to fruition. The technology is only just becoming available. It is also very expensive, but what used to be dreams of the future are now reality.

(a) **Coal Charging:** There are three systems which reduce emissions of gas considerably during oven charging, namely, sequential charging which is a method developed in Britain at the Avenue Works of National Smokeless Fuels Limited; pipeline charging to a completely enclosed system, and the use of smokeless charging cars which extract the gas from the oven being charged and treat it in a scrubbing unit on the car before discharge to air.

(b) **Coke Discharge:** There are two systems which are currently being adopted on the full scale, namely, the enclosure of the coke discharge side by a large shed running the length of the battery with the structure ventilated to treatment plants, and secondly, the discharge of coke into the movable receiving car which is hooded and ventilated to a treatment plant which can either be on the car itself or connected by a special trunking to a static unit.

(c) **Leakages:** There are hundreds of lids and doors on a coke oven battery and to keep them all leakproof is a difficult, if not impossible, task. Only by good design, constant maintenance and the proper attention of staff can we hope to reduce leakages to acceptable proportions. Training and good supervision are essential. The Alkali Inspectorate and the coke oven industry, with its Research Association, have developed a practicable method of leak assessment which is now being applied in Britain. In recent years medical science has been able to show that raw coke oven gas may have a deleterious effect on operators, so that in addition to being an amenity problem to the neighbourhood, there is a potential operator hazard. This has resulted in the Alkali and Factory Inspectorates working together closely on a common problem.

The methods mentioned briefly in (a) and (b) above cost about £500,000 to a million or more in capital, compared with the few tens of thousands of pounds earlier, to which we must add the heavy additional expense and energy usage of operation.

The second Alkali Act of 1881 added eight different kinds of industrial processes to the work of the Inspectorate and one of these was Cement Works. When her Minister brought her the Bill to sign at Carisbrooke Castle in the Isle of Wight, Queen Victoria looked out of her window at the chimneys of the nearby cement works. "I'll sign," she said, "when those are included". And they were.

Smith wrote, "I have written frequently about smoke . . . The combustion of the black of the smoke does not render the products of combustion pure, but it renders them much purer than they were and it is an enormous advantage to have the smoke bleached, or burnt rather. It may be asked what advantage? It saves clothes and furniture, and it renders the world around us more tolerable to the sight. It allows the landscape to be brighter, and the light to fall on the plants so that vegetation must be improved."

"It may, however, be said that it is not sufficient to burn the carbon. The sulphur acids are not diminished. That may be so, but as I have repeatedly said, the acid gases are always found most on trees, etc. which are most blackened by the smoke. I believe that the charcoal acts as a sponge to absorb the acid . . ." How true were his words, as we have since discovered to our cost, more so with oil burning than with coal burning. Acid soot has been recently analysed with up to 40 per cent acid and the problem is by no means completely solved yet, as I have said already. Ameliorative measures are being tried, such as control of excess air and insufflation with alkaline neutralising compounds.

Returning to the subject of salt works in his 1882 Report, Smith says, "It is, however, perfectly clear that there is a very large escape of common coal smoke of a very black character in many places . . . I think it quite possible to bring such a subject under the Alkali Act."

It was not until the Clean Air Act of 1956 that control of smoke, grit and dust from registered works became the responsibility of the Alkali Inspectorate. This was one more result of the "Beaver" Committee's work. We can all see how much more pleasant life is where smoke emissions are properly controlled, but there is plenty more to be done before we can begin to be satisfied. Whilst it is claimed that no direct correlation can be ascertained between the smoke concentrations in our clean cities and public health, yet this refers to clinical effects. I have for long held the view that dinginess can introduce extra stresses and pressures into people's lives when there are so many other pressures to face these days, and that these can be an indirect health effect which we must strive to eliminate. Professor Lawther, of the Medical Research Council, has been working on this aspect with teams from Scandinavia and the United States for several years.

Communication

I suppose it is a sign of the times that we differ with Smith so much on this subject of communication with the public and the giving of information. In his day, the policy of the Alkali Act broke new ground in Parliamentary legislation and it was received with suspicion by politicians and by the owners of works. The first Alkali Act was for a trial period of five years and it was so successful that in 1868 it was consolidated. Smith had to tread carefully and we find a peculiar mixture of detailed test results and secrecy. His early views are expressed in his First Report for 1864. "A large amount of information concerning the condensation of the alkali works has been collected, but by publishing the whole, it might be considered by many, that the report was going beyond the demands of the Act, and if I do err, I wish rather to do so on the side of caution. This is probably a feeling that the first year of the inspectorship may foster in excess, rather than the succeeding years. Besides this reason for reticence on many points, the opinion of the alkali makers, of at least one district, has been very distinctly expressed regarding the propriety of silence on certain points, whilst some have desired that as little as possible should be said on all points. Of course every information regarding any work must be considered private, unless the publication is demanded by the Act or permitted by the owner."

Within a few years Smith was devoting the major part of his report to giving all the individual tests taken by inspectors at each works, although the identities of the works were hidden behind registered numbers. At the same time, Smith referred freely to the names of works and to individuals when discussing opinions and advances in technology.

The attitude expressed by Smith persisted up to modern times in some respects, but that does not mean there was no communication with the public. It is obvious from his reports that he had their interests well in mind and that he talked with them, especially the complainants, quite regularly. When I joined the Inspectorate in 1953, it was the long-established custom for inspectors to make contact, preferably by visiting, with all complainants against registered works, to assist local authorities with their own industrial problems and to have broad discussions with local authorities, attending public health committee meetings when requested. One of the major changes in the policies of the Inspectorate in the last 20 years is a great broadening of this practice.

In 1958, with the expansion of the Inspectorate's range of duties, the then Chief Inspector issued an instruction to his staff that at least twice a year they should visit all those local authorities in which there were registered works. These visits are independent of any complaint visits and are for the object of having frank discussions about the effects of emissions on the

local environment, to obtain local authority opinion about the standards achieved, to arrange co-operation and to see what help can be given to the authorities about emissions from non-registrable works. These visits formalise what had previously been a common practice. Local authorities are free to pass on the information to their committees and the public except where it is stated to be commercially in confidence, which is rare.

The practice of visiting complainants has been maintained, but it was recognised that this was not enough in cases where there was a continuing source of pollution, either from specific works or from heavily industrialised areas. It has been our increasing practice to arrange for the organisation of Local Liaison Committees and we now have something approaching 50 of these committees in England and Wales. The composition of these committees varies, but generally they consist of representatives of the public, the local authority, the works management and the Alkali Inspectorate. Here is an opportunity for direct communication, for the public to state their complaints face to face and for the management and the Inspectorate to explain the circumstances and what steps are being taken to deal with them. Meetings are usually held from two to six times per year, depending on the wishes of the members. At these meetings, managements have learnt to be frank about their emissions and to give information freely. When inspectors visit complainants, they are often regarded as representing industry, but this is not so, and Local Liaison Committees let the public see that it is the works which are responsible for the emissions and for corrective measures. It is the Inspectorate's belief that the public should be properly informed about all emissions to air and that this is the responsibility of managements and local authorities. I was a member of the Sharp Committee which took evidence and made recommendations to Government about the presentation to the public of information on emissions to air and I believe I made a postive contribution in support. The result was embraced in Part IV of the Control of Pollution Act 1974, which is probably familiar to most of you and which I will not outline here. This is the culmination of our efforts, particularly over the past 10 years, to encourage industry to give information to the local public about its incidents and breakdowns which affect the environment, to tell of its plans and schedules and generally to behave as a responsible member of the local community. For it is the local people who matter most. It is an educational exercise which we are winning. Despite all precautions, accidents will continue to happen, and when they do it is in the best interests of all concerned to enquire into the reasons; not to allocate blame, but to minimise the chances of a recurrence. This is normal procedure in the Inspectorate.

It may well be asked where the Alkali Inspectorate fits into this information-giving picture. We have tried to be the catalysts evolving the present enlightened attitude, although our critics have sometimes presented a different picture. It has been said that, as Government servants, we should publicise everything about our testing and inspections of all registered works, submitting our reports to local authorities. What an enormous exercise and, in my view, what a waste of expert professional time. It might well be asked what other inspection agency, local or national, supplies details of its work on the lines suggested. I believe that when experts are employed to do a highly technical job, they should be allowed freedom to get on with it with the minimum of distraction and with the greatest efficiency. In Annual Reports and lectures, the policies of the Inspectorate have been explained in great detail, together with the methods used in taking decisions, setting standards and other requirements, visiting, inspecting, etc. The average results of tests are shown annually on a national basis and those of special interest are shown in the text. It may also have been noticed that the practice of naming works has been increasing year by year. We have moved steadily to a more open policy, but there are limits.

In a recent paper to the Journal of the Royal Institute of Chemistry, Dr A. Robertson, a director of ICI Limited, wrote, "The message of recent years has been loud and clear—that the community is no longer willing to be excluded from areas of decision-making which can affect its living standards in the broadest sense and we are now moving from the tripartite concept of looking after the interests of the employee, customer and shareholder, into a quadripartite concept of business involving the community, which it would be most imprudent to ignore, and this has implications in all aspects of our business and particularly in the general field of safety and its associated toxicological and environmental aspects."

On the other hand, Sir Arthur Hawkins, Chairman of the Central Electricity Generating Board, who welcomed wider consultation, open government and the debate of major policy issues in public, thought it would be counter-productive if public debate were given too free a rein. He pointed out the world of difference between wider consultation and decision taking and stated that executive decisions must be left to those who have been entrusted to take them.

In the Inspectorate we have broadened our own ideas of consultation to include Trades Union interests, because it is worthless to write standards and requirements unless the men who operate the plants are properly instructed, trained and are willing to implement the rules. In this respect we have today a much better chance than in Smith's time of succeeding in writing acceptable rules for operators; indeed they regard it as their right to take part in the exercise and we concur. In Smith's time men were alarmed when Rules for Workmen were published. How far consultation should be taken with other interests is a matter for debate. The Royal Commission on Environmental Pollution in its Fifth Report, paragraphs 202 to 208, has made recommendations for extensive consultations before final decisions are taken by the Alkali Inspectorate. My own reservations are not on consultation, but on the degree of consultation and I should be loath to embark on a programme which would reduce the efficiency of the Inspectorate without yielding any corresponding benefit. The reviewer of a recent book by Sir Andrew Bryan on *The Evolution of Health and Safety in Mines* has this to say. "The lessons to be learned from the book are many, but the most impressive is that which shows the gulf that exists between good intentions and good law. It shows that a superficial, emotional approach, unsupported by detailed scientific knowledge, can create more problems than it solves and the book clearly emphasises that successful enforcement of safety legislation can only be achieved by inspectors who have an intimate knowledge and practical experience of the industry with which they are concerned; who have, moreover, the respect and confidence of management and workers alike." We see a parallel in our own Alkali Inspectorate. On the subject of training, we have campaigned for the proper

training and instruction of managements and operators both in process control and environmental responsibilities. I like to think that the pressures we have put on scheduled industry to institute training courses have contributed to their organisation. The Inspectorate staff are committed to lecturing at these courses so that those concerned understand why they should have a responsibility for the effect of their work on the environment. Inspectors also lecture widely to all kinds of industrial and public groups to help people to understand the subject of pollution control. Similarly, I do not think it sufficient for emission information to be given to the public under the Control of Pollution Act, without an explanation of what it means. Here is an important task for the Alkali Inspectorate, Environmental Health Officers, industrialists and others with expert knowledge to contribute to public education. It is comforting to know that the Control of Pollution Act requires local authorities who want to publish information, to consult with the works and other authorities concerned at least twice a year about its presentation.

I cannot end without referring to the policy of the Inspectorate based on Best Practicable Means. This expression was enshrined in the Alkali Act of 1874 and has achieved an international reputation, being incorporated in the legislation and regulations of several other countries. It is the name we give to our comprehensive system of control and it contains all those elements which are essential for the protection of the environment. It has been described in the 110th Annual Alkali Report for 1973 and I will not go into detail here. It is a typically British system and it works. It was endorsed by both Beaver and Flowers. On page 115 of his 1867 Report, Smith said, in relation to foreign legislation which he had just reviewed, "My belief is that, comparing the attempts to legislate with the result, there has been in all cases a failure of the most decided kind. The so-called preventive system has failed."

It must not be thought from this paper that Angus Smith was the only campaigner and innovator in the Alkali Inspectorate. He had on his staff eager and creative scientists, but he was their leader. Men like Fletcher, Davis and Ballard performed phenomenal feats of investigation. Fletcher became the second Chief Alkali Inspector and carried on the work where Smith left off in 1884. Davis was an inspector for six years between 1878 and 1884 and left to pursue his own consultancy business, eventually being recognised as the Father of Chemical Engineering. His was as equally a fascinating story as Smith's. Working for the Local Government Board's medical officer in the years from 1876 onwards, Ballard travelled the country investigating and reporting on effluvium nuisances. The industrial ground he covered was enormous and his reports make good reading today. He then became an Alkali Inspector in 1882 under Smith and remained with the Inspectorate until he retired in 1914 after 32 years of service. There were many others of like character.

In those early days, inspectors in the field developed their own testing instruments, one of which, the Fletcher's Aspirator, remains today as a principal method of sampling gaseous emissions. It may seem crude, but it gives speedy results within an acceptable degree of accuracy. We now have a Task Force of a group of inspectors reviewing test methods. In the past 15 years we have concentrated on the development of continuous monitoring instruments, encouraging industry to carry out research, and ourselves placing contracts with research organisations.

Smith, Davis and other inspectors repeatedly drew attention to more efficient methods of operation, recycling of materials and conservation of energy and wastes. Today these are leading subjects for the salvation of our economy and resources. There are many examples in the Annual Alkali Reports over the last 112 years and they are worth exploring. They make fascinating reading.

In this paper I have attempted to relate the past to the present and to demonstrate the concern of the Alkali Inspectorate for the improvement of the environment by a small band of dedicated professional scientists. We have on our staff today an equally eager, dedicated and perspicacious group of scientists, many of them still comparatively young and anxioius to play their part in improving the environment in the best interests of the community, using the Best Practicable Means. I am sure Beaver would have approved.

We now have to look to the future, and here we shall be influenced not only by the decisions of the European Economic Community, but by the Government's decision on the recommendations of the Royal Commission on Environmental Pollution in their Fifth Report, under the chairmanship of Sir Brian Flowers, as to whether there should be an industrial pollution inspectorate based on the Alkali Inspectorate, and controlling the generation of certain solid, liquid and gaseous wastes. Smith, too, had responsibilities for water and solid waste, for one reads his occasional references to having to write his reports of investigations under the Rivers Pollution Prevention Act and to his control of waste heaps from the alkali industry.

The Alkali Act is the oldest continuous technology.

NOISE

Clean Air Spring Seminar 1977

The 6th Clean Air Spring Seminar was held at the Grand Hotel, Manchester on 9th and 10th March 1977. The theme of the Seminar was 'Noise'. This was a subject which, at the outset, created great interest and it was hoped that the seminar would receive good support. In the event, because of the economic climate, numbers attending were lower than hoped for; but those who did attend, found the seminar well worthwhile. In the opinion of many this was the best seminar that the Society had organised so far.

The Seminar was opened by the Lord Mayor of Manchester, Cllr. Franklin, who welcomed the delegates to the City and who made it clear that just as Manchester had made great strides and been one of the pioneers in the control of air pollution, it intended to make similar strides in the control of noise.

The first technical session under the chairmanship of Mr. Philip Draper, the Chairman of the Council of the Society, was given a good start by the presentation of a rather provocative paper by Mr. Frank Reynolds, the Director of Environmental Health of the City of Leeds and a member of the Noise Advisory Council. Mr. Reynolds' paper entitled 'Noise Control—The Present and Future Position' left few people in doubt that he was not satisfied with the present position; although the control of noise might be regarded as something new and although great efforts were being made, there was still a long way to go. Mr. M. S. Ankers of the Environmental Health Department, City of Manchester then presented his paper on 'Industrial Noise: A Case for Legislation?'. Mr. Ankers presented his paper in a most interesting and entertaining manner and highlighted the problems of noise from industrial sources. In view of the fact that consideration was now being given to development of residential property cheek by jowl with industry and commerce, a number of problems about noise would have to be resolved.

After a break for coffee, Mr. Arthur Percival a member of the Noise Advisory Council then presented his paper on 'Noise Reduction; Has Education a Role to Play?'. Mr. Percival gave a practical demonstration of how hearing could be affected by noise and then described the quiet town experiment in Darlington at some length. Following Mr. Percival's paper there was an interesting discussion and question and answer period and the three authors were kept very busy answering a considerable number of questions.

After lunch, the afternoon session got under way with a paper by Mr. C. N. Penn, the Assistant Director of Environmental Health Services, the City of Coventry on 'Noise Abatement Zones'. This paper, in some sense, acted as a foil to the remarks made at the beginning of the seminar by Mr. Reynolds, who believed in the concept of the noise abatement zone but did not believe that the noise abatement zones themselves would be as effective as originally hoped.

There was then a slight switch of subject to 'Noise from Transport' and the question of reduction at source. Mr. J. W. Tyler of the Transport Engineering Division of the Transport and Road Research Laboratory gave a very interesting talk on what was being done towards the production of the quiet lorry. It was quite clear that much had been done and much more could be done, but it seemed that it would still be at least ten years before such vehicles are seen on our roads. In contrast, Mr. R. J. Hill of the Aero Division of Rolls Royce (1971) Ltd was able to show that the aircraft industry had already made great strides in the reduction of noise at source from aircraft and that further reductions could still be made.

Again, an interesting discussion followed but surprisingly, most delegates seemed to accept that traffic noise was something that was here to stay and something that people would have to endure.

After tea there was a demonstration of noise measuring equipment. Equipment was on display from four firms and some of their representatives addressed the delegates. Much of this equipment was on display throughout the whole period of the seminar and the display area was visited by many delegates who showed a great deal of interest.

This left ample time for delegates to get ready for the next event which was a civic reception and cocktail party given by the Lord Mayor and Corporation of Manchester in the Town Hall. Although the Lord Mayor was unable to be present at the reception because he was involved in a Royal Visit to the City, a former Lord Mayor, Cllr. Grant, now Chairman of the Environmental Health Committee and Mrs. Grant, very kindly acted as host and hostess and were most hospitable. This was a most enjoyable occasion.

On the Thursday morning, session five under the chairmanship of Rear Admiral Sharp, dealt with two further aspects of noise. Mr. Ralph Harrison of Imperial Chemical Industries, spoke about 'Noise and the Worker'. This, in a way, was a paper which was different from the rest in that it was concerned with noise inside the works as opposed to noise outside a factory or in the streets. Mr. Harrison presented a most interesting paper which made very clear to delegates the difficulties that industry experiences in this field. This was followed by a very practical and down to earth presentation from Mr. D. L. Barry of Messrs. Atkins Research and Development on 'Noise from Construction Sites'. Mr Barry made it very clear what could be done and what should be done.

After a coffee break there was a discussion period and question and answers on the two papers that morning and this then led on to a general discussion of the whole seminar at which all authors who were still present took part. The theme that came out of this general discussion was that

co-operation rather than confrontation was the key to solving the problems of noise. This was already being practised and further improvements could be expected in the future.

After lunch, delegates were able to visit the Manchester International Airport where they saw demonstrations of noise measuring equipment and displays of the flight paths used. It was clear that the Airport Authority had this question of noise from aircraft very much at heart and were doing their best to alleviate the problem—but they still have a problem, a considerable one.

Altogether, this proved to be a most interesting seminar from which all who attended learned something. All the papers were of a very high standard and the authors presented them in an interesting and provocative manner. This led to a great deal of useful discussion and delegates were not frightened of asking questions and making their own views known.

The Noise Advisory Council and its work

Noise is more than a mere nuisance: it can impair efficiency, cause accidents and (in certain industrial situations) even lead to hearing loss. Unfortunately, in our society noise is on the increase. As car ownership increases, more and more goods are moved by road; holidays abroad become more common, and the penalty of increased noise from road and air traffic which results is a heavy one. Though the technology is already available to reduce noise, it is not as readily applied as it might be. At the same time, many of us from time to time make more noise than perhaps we should—in and around the home, in parks and on beaches, in our cars and on our motor-cycles.

Against this background, the Noise Advisory Council was set up by the Government in 1970 with the following terms of reference:

> "To keep under review the progress made generally in preventing and abating the generation of noise; to make recommendations to Ministers with responsibility in the field; and to advise on such matters as they may refer to the Council."

The Council's Chairman is the Secretary of State for the Environment. The Deputy Chairman, who is a Junior Minister of the Department, usually chairs the quarterly meetings of the Council, which are held in London. The Council comprises about 24 members, drawn from a wide field including local government, universities, industry, trade unions and environmental associations. Members are appointed by the Secretary of State and usually serve for terms of three years. Secretarial Services are provided by the Department of the Environment's Noise Policy and Clean Air Division. Meetings of the Council and its Working Groups are usually attended by assessors from various government departments who are available to give technical advice.

Most of the Council's basic work is done by Working Groups which meet regularly. These Groups, consisting of about seven members, examine specific aspects of the problems of noise and make recommendations to the full Council. Subjects currently being studied by Working Groups include:

- Noise as a hazard to hearing
- Noise from surface transport
- Noise from air traffic
- Education, publicity and information requirements
- Implementation of the Control of Pollution Act 1974.

In addition, a technical sub-committee deals with specialists noise problems, and a Steering Group reviews and guides the work of the Council as a whole.

The Council has published a number of reports and public information leaflets.

In co-operation with the Department of the Environment and the Central Office of Information, the Council has produced a mobile exhibition on noise. This first went on tour in July 1975 and is available to local authorities throughout the country. The purpose of the exhibition is to illustrate the damage that noise can do and the means of redress that are open to those subject to excessive noise from whatever source.

Enquiries about the work of the Council should be addressed to: The Secretary, Noise Advisory Council, Queen Anne's Chambers, 28 Broadway, London SW1.

A Special Case of Air Pollution—Noise

by

Michael Briers

John Cleveland College, Hinckley, Leicestershire

This was one of the winning essays in a schools competition organised by the East Midlands Division.

Noise, as defined by the Wilson Committee on noise of 1963, is ' sound undesired by the recipient '. Sound is caused by something vibrating causing surrounding air to vibrate by compressing and then expanding the air molecules. So noise or sound is air molecules moving, therefore the air is polluted with these unwanted vibrations.

For centuries people have assumed that deafness was part of the normal ageing process. Now evidence is accumulating suggesting that this is not true, but caused by the continual bombardment of our ears by noise.

Many people are subjected to high levels of noise, with-

out realising the damage being done, becoming used to the noise. Young people, especially, do not realise the damage being done by some noise, they are bred with them and accept them as a part of life. As life becomes more mechanised, more machines, cars, planes and even household noise increases, causing greater damage.

Much of the damage caused is not noticed, as most damage is done above the frequency of normal speech. Our eyes are able to cut out bright light but not our ears to noise.

The middle ear contains muscles which react automatically to protect the inner ear from excessive noise. When an intense noise occurs, the muscles contract, tightening the eardrum and the tiny bones in the middle ear. This action prevents the full force of the vibrations from being transmitted to the inner ear. But these muscles can become weakened by too much use, and no longer be able to reduce excessive noise effectively.

When a sudden noise strikes the human ear, the heart beats rapidly, blood vessels tighten up and the stomach, oesophagus and intenstines contract. Noise affects the digestive system, reducing the flow of saliva and gastric juices, this reaction often causes nervous indigestion, which can lead to stomach ulsers, if noise continues.

Noise can also cause mental and emotional illnesses, not only as a result of its physical effects on the body, but also because of its direct influence on our thoughts and feelings.

Even the home can be considered noisy. The noises produced are endless, the hum of a refrigerator, water running, door slamming etc. Many so-called slightly noisy things produce high levels of noise and can be damaging; an alarm clock produces 80 decibels and a baby screaming produces 92 decibels.

Many people buy home equipment without thinking about the noise that is produced, considering first how much easier life will be with it. Doctors have, in America, suggested that home noise may well be a factor in pushing up the divoice rate, widening the generation gap and breaking down American family life.

Of all the forms of noise pollution, the one that disturbs and bothers more people is traffic noise.

Cars, motor-cycles, lorries and buses give off noise from their engines, exhaust pipes, tyres and horns. These noises are reflected off the hard pavements to and fro between buildings. If people are trying to concentrate on reading, writing, talking, sleeping or any other every day activity some parts of their brains are being distracted by the noise of traffic.

The number of cars, motor-cycles, buses and lorries increases every year, with an increasing amount of noise. The move away from railways to lorries, carrying goods, has produced bigger and even louder lorries.

In the internal combustion engine, explosions occur in the cylinders to produce power. The gases produced by these explosions are released from the engine via the exhaust pipe to the air. But because the exhaust gases are hot and under pressure they make a loud noise if they are released directly into the cooler outside air. So, to stop this, silencers are fitted onto the end of the exhaust pipe. On some sports cars and motor-cycles the silencers recreate this loud noise, to give the car or motor-cycle a sporty or dashing style.

The energy produced in the cylinders is transmitted to the wheels of the car by a series of moving metal parts, creating noise as they rub together. This noise can be reduced by using high-grade metals, but many manufacturers and consumers consider this an unnecssary addition to the cost of the car.

Noise is also produced by air turbulence around the bodywork of the car. Every blunt projection from the car's body causes this turbulence. This turbulence can be greatly reduced by shaping the bodywork of the car in an aerodynamic way.

Tyres are a continuous source of noise, especially when a car is moving at high speeds. They vibrate on contact with the road and the vibrations are transmitted through the wheels and the axles into the body so that the whole car vibrates and causes still more noise. Some of the noise can be reduced, but some is unavoidable as tyres are designed for safety.

By law a horn has to be on a car to avoid accidents, but if they were only used for this nobody would complain. They are used to attract the attention of somebody, or to say good-bye. Many horns produce sound of about 90 decibels, with the sound increasing slowly every year, so the horn can still be heard above the noise of ordinary traffic.

The only real effort to reduce the noise the car makes by the manufacturers is to reduce the level of noise inside the car.

Another large source of noise is the noise made by aircraft in the air. Air transport has come a long way since Louis Bleriot flew over the Channel in his monoplane. Now Britain has to contend with supersonic aeroplanes, subsonic jumbo jets, helicoptors, what next?

The noise is not too bad when the plane is in the air, but becomes bad when the plane lands and takes off.

So, at these two places noise has be reduced. This can be reduced by reducing the noise of the actual plane, controlling the selling of land near airports, trying to avoid densely populated areas and control on night flights and the siting of new airports away from populations living near.

It is reported that people near Heathrow Airport suffered more from mental illness than people from quieter areas.

There are other sources of noise, the construction and destruction industries, with their high technological equipment, produce vast amounts of noise. Industrial noise also adds to the noise burden that people have to put up with.

The dangers of noise cannot be overstressed. In America it was predicted that if the noise level rose in some cities by 1 decibel per year, the inhabitants would be stone deaf by the year 2000 and then the further populations being born deaf.

People, especially young people, get used to the noise, but at what physical and social cost?

The warnings are there, but people must take action instead of delaying it. Determined efforts should be made by manufacturers to reduce the noise of their products.

The Darlington Quiet Town Experiment

Darlington Borough Council, in conjunction with the Noise Advisory Council and the Department of the Environment, are participating in a unique two-year experiment. This was officially launched on 20th September 1976 by Mr. James Batho, Parliamentary Under Secretary at the DOE.

The idea for the Quiet Town Experiment was conceived by the NAC and was one of the recommendations in their booklet 'Noise in the Next Ten Years' published in 1974.

The experiment is being held because the NAC wants to find out and demonstrate what can be done towards reducing every-day noise problems in a typical town by a combined effort involving local residents, the local authority and business and other interests, and by applying modern technology to reduce the noise impact of traffic and industry. The experiment is deliberately 'low cost', with budget of £30,000. About half of this amount is for social surveys before and after the event.

Darlington was selected for the experiment because it it is a conveniently sized, compact town with a good cross-section of housing development, old and new. It also has a wide range of industry, some of which is close to residential areas and so poses noise problems that need to be solved. Another advantage is that most through traffic now bypasses the central area of the town, leaving only local traffic. Therefore, the experiment is not likely to be distorted by convoys of juggernaut lorries cruising down the main streets.

Darlington is a community with a sense of identity and civic pride. Its Environmental Health Department—concerned with noise as well as many other matters—is experienced and well equipped. The Council itself is sympathetic to the idea that everyone is entitled to a fair measure of peace and quiet.

But the object of the experiment is not to make Darlington "as quiet as the tomb". The town is a lively place. And wherever people shop, work, travel and relax there will be some noise. However, there are noises and noises—some a pleasant background, some an irritating disturbance. The object of the experiment is to see how the irritating noises can be eliminated as far as possible. Factories will be given advice by noise experts from the Environmental Health Department on means of reducing obtrusive noise, and the results will be checked. Planning Officers will be scrutinising the noise implications of new development and advising applicants and the Borough Council on schemes that may require amendment. Motorists will be offered exhaust system checks by local garages—and will be asked not to rev vehicles unnecessarily. Vehicle operators will be asked to check maintenance routines, so that worn-out exhaust systems are replaced before they become noisy, engines are properly tuned and bodywork maintained to eliminate unnecessary rattles.

In connection with trying to reduce the ambient noise level, the Committee are looking for materials, techniques and methods of Noise Control which can be applied. Firms producing Noise Control Equipment or materials engaged in Noise Control Methods and techniques are invited to contact Mr. W. C. B. Robson, Borough Environmental Health Officer, Department of Environmental Health, Town Hall, Darlington DL1 5SU. Tel: 0325-60651.

NOISE, VIBRATION AND POLLUTION SURVEY

The Environmental Sciences Research Unit (ESRU) at Cranfield Institute of Technology has undertaken a comprehensive survey of the noise, vibration and pollution conditions in the small market town of Newport Pagnell in Buckinghamshire. The survey brings together the current range of measurement and analysis techniques used for such environmental monitoring and provides a useful introduction to a new service offered by the Unit.

The ESRU team have worked for several years on problems of noise, vibration and pollution measurement and control. This expertise has now been integrated into a comprehensive service offered by the Unit which thus includes all the major environmental parameters.

Whilst ESRU enjoys the advantages of university facilities and administrative assistance, it is a self-supporting contract research unit undertaking independent and competitively costed work for both industry and Central and Local Government.

NOISE AND THE LAW

An international symposium on European legislation on noise, entitled "FASE 77", is due to be held at Wembley on 14th-17th November 1977.

The conference will try to encourage a common and more positive attitude towards noise reduction and its consequences in the whole of Europe. The first of its kind in Europe, the conference is open to all people involved in the study of noise, its consequences and its legislation.

Introduced by Denis Howell, Minister of State for the Department of the Environment, "FASE 77" is organised by the Institute of Acoustics in the name of the Federation of Acoustical Societies of Europe, in association with the British Society of Audiology and the Department of the Environment.

Further information may be obtained from: FASE Symposium Secretary, Owles Hall, Buntingford, Hertfordshire.

POLLUTION ABSTRACTS

Papers presented to the NSCA 6th Technical Seminar, Manchester, 9th and 10th March 1977

55 Noise Control—The Present and Future Position. F. Reynolds, Director of Environmental Health, City of Leeds, and Member of the Noise Advisory Council.

The paper shows that 'Progress' in transport and construction technology has been achieved at the expense of ever-increasing noise levels in urban, residential areas. The most effective protection for people forced to live alongside juggernaut-bearing roads, international airports or flimsily constructed engineering works, is to be sealed inside their noise-insulated homes. A broad view of noise control is presented, with topics under separate headings. The functions of the Noise Advisory Council are outlined, then the main problems of noise control are considered in the light of available legislative procedures, with particular attention to new measures under the 1974 Control of Pollution Act. Surface transport noise and air traffic noise are assessed in terms of their effects upon the community and the increasingly adverse public reaction to this form of pollution. The future of control is examined against this background, especially with regard to the role of LA environmental health departments. Finally, the increasingly important influence of EEC legislation, and the areas in which British policy conflicts with the EEC's 'Harmonisation' Standards, is discussed.

56 Industrial Noise: A Case for Legislation? M. S. Ankers, Principal Public Health Inspector (Noise), City of Manchester.

The paper considers procedures for the control of developments which might give rise to increased industrial noise. Legislation now exists to permit control of all stages of development, from construction through operation to demolition. The controls available are discussed fully under two headings, advance planning and remedial control. Controls still needed are examined in the context of UK membership of the EEC, and the question of noise standards and guidance. Control is considered from industry's point of view in relation to economic and planning factors. Emphasis is placed on consultative and co-operative procedures which need to be reinforced and followed by both industry and local authority.

57 Noise Reduction: Has Education a Role to Play? A. J. Percival, MBE, Member, Noise Advisory Council.

Unless economic incentives can persuade a noise producer to defray the substantial cost of abating the problem, regulations are necessary to enforce reduction of industrial noise. With the general public, the lack of awareness of noise selfishly produced requires the remedy of education. The educative role of the Noise Advisory Council in this respect is described. U.K. initiatives in noise control are considered, with the work of the NAC as centrepiece. Full details of the Darlington Quiet Town experiment are given. This is regarded as a test case for both the U.K. and the EEC. Other prominent U.K. initiatives mentioned include those of the Noise Abatement Society, government establishments active in assisting the NAC, industrial producers of noise control equipment, and national non-governmental organisations.

58 Noise Abatement Zones. C. N. Penn, Assistant Director of Environmental Health Services, Coventry District Council.

Part III of the 1974 Control of Pollution Act provides for the introduction of noise abatement zones, on the lines of smokeless zoning. This became operative on 1st January, 1976. The author points out that insufficient experience has been gained in its implementation to enable any other than general conclusions to be drawn. The emphasis of the Act is on prevention, rather than cure, and the paper is written in this context. The principles of noise abatement zones are explained with an indication of the greatest benefit to be achieved by the use of these powers. The legislative powers available to Local Authorities are considered in detail. The practicable implications of the Act are discussed with reference to administrative problems and difficulties associated with measurement of noise from classified premises.

59 The Reduction of Vehicle Noise at Source. J. W. Tyler, Transport Engineering Division, Transport and Road Research Laboratory.

This paper identifies the sources of vehicle noise, their relative importance, and the means by which the noise levels can be reduced. A brief description is given of the TRRL Quiet Heavy Vehicle project. This aims to produce a maximum gross weight articulated diesel engined vehicle emitting about the same noise level as a current private saloon car about 80dB(A).

60 Aircraft Noise as a Form of Pollution. R. J. Hill, Rolls-Royce Ltd.

Aircraft noise, while rarely injuring hearing, causes annoyance to the point of misery to residents near airports. Public pressure has resulted in action against this noise in the form of certification, operational restrictions and land use planning. The paper concentrates on certification and the impetus this gives to improvements in technology. Aircraft noise measurement is explained. The factors in noise regulation and certification are considered. Noise sources and methods of control in both subsonic and supersonic aircraft are examined. Figures and diagrams are used to illustrate technicalities. Operational restrictions, particularly on approach to airports and on nightflights, are outlined. Land use planning is also considered; the author points out that an ideal situation is very rarely attainable and that a high cost to the community is incurred in noise control, which necessitates the enforcement of consistent regulations.

61 Noise and the Worker. R. Harrison, ICI Organics Division.

Most of the work related to the recognition of noise-induced hearing loss sustained during employment has taken place since the 1950s. However, the author cites interesting examples of the recorded history of workers' exposure to noise, from Italy in 1713 to Glasgow in 1886. In spite of research since that time, it is shown that only one piece of work place noise legislation has come into being, although in 1972 the Department of Employment's 'Code of Practice for reducing the exposure of employed persons to Noise' set out recommended limits to noise exposure and described methods of measurement. This (voluntary) Code is summarised in the paper, as are the recommendations of the Industrial Health Advisory Sub-Committee on noise. Compensation for hearing loss is discussed; the author explains which workers are

at present eligible for disablement benefit. Foreseeable developments in legislation for both noise control and workers' compensation are explained, and in conclusion the optimum solution, removal of noise at source, is briefly considered.

62 Noise from Construction Sites. D. L. Barry, Atkins Research and Development.

This paper deals with the general philosophies and legislation relating to construction noise and does not attempt to describe the acoustic elements of construction noise sources. The framework within which any acoustic assessment would be made is, however, explained. Existing legislation relating to construction noise is outlined, and the procedures by which noise control can be attempted are described in detail. The establishment of noise requirements and the approaches which will help to achieve desirable noise standards are discussed. The means by which noise can be controlled are briefly examined, and a description given of how protective measures might be considered. Finally, the cost of noise control, from the contractor's viewpoint in particular, is assessed in terms of the cost of compliance and the cost of non-compliance with the legislation.

New Smoke Control Orders

The lists below are supplementary to the information in the last issue of **Clean Air (Spring 1977)** *which gave the position up to* **31 December 1976.** *They now show changes and additions up to* **31 March 1977.**

Some of the areas listed are new housing estates, or areas to be developed for housing. The total number of premises involved will therefore increase. An asterisk denotes that there have been objections and that a formal inquiry has been or will be held.

The list of new areas in operation of smoke control is based on the plans submitted to the Department of Environment, but may erroneously include some local authorities who have made postponements, without notifying the Ministry of the fact.

ENGLAND

NEW SMOKE CONTROL ORDER IN OPERATION

East Midlands
South Kesteven No. 9 (Stamford No. 1).

NEW SMOKE CONTROL ORDERS CONFIRMED BUT NOT YET IN OPERATION

North Western
Chorley No. 2 (Clayton Brook).

Yorkshire and Humberside
Harrogate (Tockwith Scheme 1).

South Western
Cheltenham No. 8 (Charlton Park) and No. 9 (Running Track).

NEW SMOKE CONTROL ORDERS SUBMITTED BUT NOT YET CONFIRMED

Northern
Carlisle No. 5; Gateshead Teams No. 6; Newcastle upon Tyne No. 3 (Castle Ward) No. 10 (Gosforth) No. 24 (Newburn) and Nos. 26-29.

North Western
Hyndburn No. 38; Trafford (Bowdon/Bucklow No. 1).

Yorkshire and Humberside
Barnsley No. 9 (Thurnscoe) No. 10 (Darfield) No. 11 (Monk Bretton) and No. 12 (Old Hill); Harrogate (Tockwith Scheme 1); Wakefield No. 1 (Featherstone) No. 2 (South Kirkby) No. 9 (Knottingley) and Wakefield (Middlestown).

West Midlands
Coventry No. 19; Dudley No. 137 (Oldswinford); Warwick Nos. 7 and 8; Wyre Forest No. 1.

East Midlands
Gedling No. 5; Lincoln No. 14.

South Eastern
Gravesham No. 3.

London Boroughs
Bromley Nos. 29-31; Hillingdon Nos. 31-33; Wandsworth No. 7.

NORTHERN IRELAND

NEW SMOKE CONTROL ORDER IN OPERATION

Down D.C. No. 1.

NEW SMOKE CONTROL ORDER CONFIRMED BUT NOT YET IN OPERATION

Antrim D.C. No. 5.

NEW SMOKE CONTROL ORDER SUBMITTED BUT NOT YET CONFIRMED

Castlereagh D.C. No. 4.

SCOTLAND

NEW SMOKE CONTROL ORDER IN OPERATION

Renfrew District (Barrhead No. 5 Central).

NEW SMOKE CONTROL ORDERS SUBMITTED BUT NOT YET CONFIRMED

City of Edinburgh District (St. Bernards); Clydebank District (Kilpatrick North); Nithsdale District (Lochside South) and (Georgetown South).

WALES

NEW SMOKE CONTROL ORDERS SUBMITTED BUT NOT YET CONFIRMED

Delyn B.C. Nos. 1-10.

SMOKE CONTROL AREAS

Progress Report

Position at 31st March 1977

(Figures supplied by the Department of the Environment, The Welsh Office, the Department of the Environment for Northern Ireland and the Scottish Development Department).

	England			*Wales*			*Scotland*			*Northern Ireland*		
Smoke Control Orders Confirmed prior to 31.12.76	4,740			21			252			72		
Acres		1,570,942			2,912			137,112			16,772	
Premises			6,863,974			10,499			575,700			47,509
Smoke Control Orders Confirmed (31.12.76-31.3.77)	4			—			—			1		
Acres		148			—			—			835	
Premises			45			—			—			535
Totals	**4,744**	**1,571,090**	**6,864,019**	**21**	**2,912**	**10,499**	**252**	**137,112**	**575,700**	**73**	**17,607**	**48,044**
Smoke Control Orders Submitted (31.12.76-31.3.77)	35			10			4			1		
Acres		30,349			369			5,967			621	
Premises			63,146			—			2,728			1,731
Grand Totals	**4,779**	**1,601,439**	**6,927,165**	**31**	**3,281**	**10,499**	**256**	**143,079**	**578,428**	**74**	**18,228**	**49,775**
Smokeless Zones (Local Acts) in Operation ..	44			—			—			—		
Acres		3,400			—			—			—	
Premises			41,060			—			—			—

BOOK REVIEWS

Combustion-Generated Pollution

Inter-committee Working Party of the SRC's Engineering Board. Chaired by Prof. J. M. Beer. Science Research Council, July 1976. 92 pages

Pollution from combustion sources is by far the largest source of atmospheric pollution in industrialised countries and urban areas. This report considers both stationary and mobile sources of emission. As has already been proven, suitable research and technical development to modify and control combustion processes can lead to reduction in the emission of pollutants. The report demonstrates that the most effective method of reduction lies in increasing the thermodynamic efficiency of the energy conversion process; research devoted to energy conservation will thus help to reduce emissions from fossil fuel combustion. A summary of recommendations is made in which a number of priority areas are identified, ranging from basic thermodynamics and kinetic studies to mathematical modelling of flow patterns in combustors. A particular recommendation is that all research in combustion technology in the UK should be brought together in a national ten-year programme with the aim of achieving a balanced, interrelated set of projects and ensuring that the most sensible use is made of available resources.

Figures and tables showing levels of combustion-generated pollution in the USA and the UK are included. The mechanism of the formation of seven main pollutants is described in the second section of the report. The effect of design and operation variables on the emission of pollutants is examined in section 3. Then follow three sections dealing with the common sources of pollution: power stations and process plant, internal combustion engines, and gas turbines. An appendix, entitled 'A Survey of University Work', is also given. The report was prepared following surveys of the state of the art, work underway in universities and polytechnics and consultations with representatives of industry. It is expected to be of interest to universities, polytechnics, industry and government, although action on the recommendations will depend on the financial resources made available to the Council and upon the timeliness and promise of research proposals submitted.

Copies of "Combustion-Generated Pollution" can be obtained, free of charge, from the SRC Chemical Engineering and Technology Secretariat (Mr P. J. Bullard, ext. 211) at State House, High Holborn, London WC1R 4TA.

The Protection Handbook of Pollution Control

Peter Sutton. Alan Osborne and Associates. 1975. 80 pages. £1·50 (including postage and packing)

The author, a mechanical engineer, has had more than 22 years' experience in the petrochemical industry. For the last twelve years, Mr. Sutton has specialised in environmental engineering: the control of air and water pollution, and noise. The material which forms this handbook was originally published as a series of articles in Protection magazine; these have been revised and updated. Separate chapters cover air pollution, water pollution, and waste disposal. These is no chapter devoted specifically to noise, although this is referred to in various chapters (on basic principles of pollution control, the law relating to pollution, and objectives and the environmental audit); the author has written separately a monograph on noise, The Protection Handbook of Industrial Noise Control (see Book Review, C. A. Winter, 1975, p. 22). The omission of 'industrial' from the present title indicates that the intended readership is more general, although the emphasis is still very much on industrial pollution. But this survey is concerned with pollution as it affects and damages the environment as a whole, and as it causes offence and health damage to people in every sphere.

The chapter on air pollution, the longest in the handbook, contains a wide range of information in a concise text illustrated by diagrams, photographs and tables. There is a particularly useful figure showing atmospheric dispersal of flue gas and the pattern of ground level concentration from a single chimney emission. It is not ideal to summarise in a couple of columns a complicated subject such as atmospheric dispersal, but the author's experience has produced an explanation which is a lucid basis for understanding, taken in conjunction with a diagrammatic representation. Furthermore, the space limitations imposed are acknowledged, and reference is made in a Bibliography at the end of the book to standard text books on all the subjects covered. In this context, it is disappointing to see the NSCA Year Book misrepresented as a 'journal' rather than as the standard work of reference it has become. The author seems to have benefited from the Year Book's example: he includes for instance, a Glossary of some useful terms, relating to pollution in general. Naturally enough, the coverage of air pollution terms cannot be compared to that in the NSCA Year Book; completeness is forestalled by lack of space. The definitions also are not so full, although in general agree in sense. It might have been better, for the sake of space saving, if the 'useful terms' had been confined to those used, but not defined, in the text. There are a few instances of repetition.

The summary of Law relating to Pollution has again obviously benefited from the many publications devoted specfically to this subject. But the advantage in the present instance lies in the author's ability to distinguish the most important feature of each act and to present a succint account of the appropriate sections under which the various types of air, water, land and noise pollution can be controlled.

Altogether, this is a comprehensive survey of many aspects of pollution control which, because of its very reasonable price and its clarity of expression, should have a wide market. Students of environmental sciences would find it a valuable introduction to many aspects of study, but it would be even more beneficial if it were to be found, well-thumbed, in the offices of works managers throughout the UK. For the smaller industries, it is a valuable general guide for managers who might lack experience of the demands of pollution control. For those in charge of large plants, who may well employ pollution control specialists, perusal of this handbook will ensure that the general manager is cognisant of an important part of his company's activities. In this connection, the chapter on 'objectives and the environmental audit' should be particularly useful, since it describes methods by which a company's activities can be guided along legally permissible and socially acceptable lines (re. the environment), and in an efficient manner.

An Addendum to the Bibliography is included with new copies in order to bring the legislation up to date.

Strategy of Pollution Control

P. Mac Berthouex and Dale F. Rudd. Published by John Wiley & Sons Ltd. 579 pages. £14·20

The authors of this book are respectively teaching environmental engineering at the University of Wisconsin and Professor of Chemical Engineering at the same University. They are therefore well equipped to provide a text book for students of environmental engineering. For this work is essentially a text book rather than a book of reference. Nevertheless, the information it contains is extremely valuable and helpful and many of the case studies quoted

are interesting if not illuminating. For this reason the book would have been very much improved, and indeed would probably rank as a useful work of reference, if a more adequate index had been provided.

The authors acknowledge that pollution control is so broad a topic that no single book can deal with all the important issues. The book therefore approaches the whole subject in a new way in that it integrates principles applicable to all areas of environmental pollution control. Many examples and case studies are given and the book is written in a style which is not only readily understandable but also very readable. The work proceeds from first principles to system integration and policy studies. The environmental system is examined and there are sections on the analyses of material flow and of energy flow. Other sections consider the strategic use of industrial chemistry, the practice of processing with living organisms, and separation systems.

At the end of each section, problems based on the information given in that section are set for the use of students. These problems are essentially practical, and are of the sort which any environmental engineer or indeed environmental health officer might well have to deal with.

This is a useful and valuable text book of a new kind with a refreshing approach. How much better it would have been if a really adequate index had been provided.

Manual on Urban Air Quality Management
WHO Regional Publications European Series No. 1. M. J. Suess and S. R. Craxford, editors. WHO Regional Office for Europe, Copenhagen, 1976. 200 pages. Sw. fr. 36, US $14·40. Available from HMSO

Work on this manual was begun in 1971 as a result of the development of a long-term programme of environmental pollution control within Europe. Many of the chapters were commissioned at that time, reviewed by special working groups, and subsequently revised by the authors. Three chapters are of later commissioning, also revised after comments. Chapter 3 is the result of a WHO Expert Committee report on guides and criteria for urban air pollutants, and chapter 10 of an international WHO-sponsored symposium on air quality monitoring systems. Other chapters by international experts make up an experienced guide on ways and means of controlling air pollution through the application of legislation and technology.

Dr. S. R. Craxford, co-editor, wrote the first chapter as a review of the whole field of air pollution control and abatement, prepared especially for administrators and policy makers. He brings into focus the knowledge required for the political, technical and administrative decisions necessary to formulate a complete control policy. Both existing problems and the avoidance of pollution in the future, are discussed, with separate coverage of pollution from road vehicles and pollution surveys. The general principles of action, from the moment awareness of pollution is openly expressed as public dissatisfaction, are treated specifically and separately in subsequent chapters.

Chapter 2 is a lawmaker's guide to current and alternative practices in air pollution control legislation by G. A. Persson; as this deals with approaches and principles of legislation, and not with regulations formulated from these principles, this chapter should not ' date ', but can be used as a reference in the search for relevant legislative and administrative machinery. Chapter 4 comprises a very technical justification of ambient air quality standards, with a description of their application. Statisticians and those with a peculiar aptitude for theoretical planning would revel in this exposition; others might find the papers on the subject given at the 1975 Brighton Clean Air Conference easier to digest. Chapter 5 considers the stress placed on the environment by an increasing pressure of population and the provision of necessary housing. Industry, as a major source of air pollution, is reviewed in the light of criteria for its location. General guidelines are proposed on the basis of models for town and country planning in the Rijnmund area, The Netherlands. The application of economic principles to air quality management is discussed in chapter 6. The factors involved and the criteria of cost/benefit, vary so much in each situation or country that a simple formula for dealing with the economic aspects of air pollution could not be proposed, so from the discussion of general principles, application factors and alternative methodology have been derived, the end results of which are predicted in theory. Chapter 7 concentrates on meteorological conditions as they affect air pollution, locally, regionally and globally. Background technical information is supplied, and examples of direct interactions between air pollution and weather conditions are used with reference to topographical and building considerations. Plans for action cover modelling, forecasting and monitoring requirements.

' The Preparation of an Air Pollution Inventory ', chapter 8, displays many neat examples of forms to be used in data gathering. The terminology and methodology is US-orientated and would need considerable adaptation were it to be applied in the UK—if indeed such inventories could be afforded here. Perhaps they would make bulky and impressive additions to future County Structure Plans? The chapter on air quality surveillance systems has similar drawbacks as far as the UK is concerned. It is so comprehensive and couched in such forbidding expertise, that hopeful Environmental Health Officers might find difficulty in recognising the tools of their trade. This is not a criticism that should be applied to the manual as a whole, since its value lies in presenting the range of air quality management methodology available worldwide, from which a choice of procedures, suitable to individual circumstances, may be made.

Environmental Factors in Urban Planning
E. Grandjean and A. Gilgen. Taylor and Francis Ltd., London. 1976. 197 pages. £9·75

This book is a compendium of technical information on environmental factors. The authors have tackled the complexities involved in the issues of air pollution, noise, urban open space and solar exposure in the urban setting. They have attempted, with each of these issues, to define the physical, chemical and social phenomena, describe their effects, and list technical descriptors and criteria. The authors have employed an extensive table of contents and index which greatly enhances the reader's ability to use the book for a basic reference text.

A work such as this has a place on the shelf of an urban planner's library. While dealing with complex technical matters, the book remains quite readable and would appear to be quite useful in the development of the environmental component of an urban plan. The book appears to be a first step towards developing the technical competence required of planners for addressing environmental factors. As such, it makes an excellent complement to books such as those which address the more administrative aspects of planning.

However, there are several problems with this book which make a positive critical review difficult. The first problem arises from the fact that much of the material in the book is out of date. The most recent citation is four years old. Only 12% of the technical works cited are less than seven years old. As a result, a significant amount of fairly recent research into air and noise pollution is not mentioned. This problem arises out of the book's origins, being based on four reports written in 1965 and consolidated into a book published in Switzerland in 1973. The present volume appears to be a direct translation of the 1973 work.

A second problem arises with the fact that the book does not include any reference to the issue of water pollution. There are several useful urban planning perspectives from which this critical environmental issue could be addressed

but the authors have not seen fit to include water quality. There is a body of research in this area which deserves at least a review in a volume such as this.

I feel that this type of book is an important addition to the environmental planning literature. A movement away from mere concern for environmental quality toward technical competence in addressing the issues is needed. However, the hallmark of environmental planning is that it is very dynamic with an information base which has greatly expanded in the last five years. The content of this book is probably too dated to be of use.

Robert O. Otto,
Visiting Fellow
Science Policy Research Unit
University of Sussex

Handbook of Ventilation for Contaminant Control
Henry J. McDermot. Ann Arbor Science Publishers Inc. (John Wiley & Sons Ltd., Chichester). 368 pages. £17·75

Although this book is written primarily for the American market, and is very much tied to the standards set by the Occupational Safety and Health Act of the United States, it does have an application in the U.K. as it brings together and clearly sets out the principles of ventilation and their practical applications. The aim of the book is to help the reader to use ventilation, especially local exhaust ventilation, effectively.

Most of the book is related to the environment inside the place of work, but community environmental protection is by no means neglected "for environmental protection systems the aim is to remove materials so that residual in the discharged air meets air pollution standards".

Various ventilation systems are described in detail and clear sketches illustrate the mistakes often made in the past with uncomfortable results for the unfortunate work people.

Essentially a text book for the heating and ventilating engineer, this handbook is also a very useful guide for plant managers and those concerned with safety within the works. It includes chapters on hazard assessment, how local exhaust systems work, the importance of hood selection and design and the design of ventilation systems themselves. Fans are obviously an important part of any ventilation system these days, and as might be expected, there is a comprehensive section dealing with these important machines. The economics of ventilation systems are not neglected and there is a chapter dealing with the solving of specific ventilation system problems.

The book is written in a clear, incisive style and is very readable, even to the layman; it would be improved with a better index.

Coal—Technology for Britain's Future
Macmillan, London. 1976. 144 pages. £4·95

This review of coal as a source of energy and raw materials, and coal-mining as an industry, is composed of six essays by eight experts. The names of some, if not all, of the contributors will be recognised by those interested in reading such an account. However, a biblographical note on each would have been useful, if only to substantiate the claim made on the book's sleeve the authors "hold detached and sometimes critical views of our coal industry". In fact, the note of expertise is so pronounced that it is easy to suppose that many of the contributors have an inside knowledge of the industry.

The world's coal reserves are vast, although as Roger Vielvoye points out in his chapter on the significance of coal as a world energy resource, the technology for economic extraction of the greater part of these reserves does not yet exist. But since the oil crisis of 1973, the importance to the UK of its coal resources has become increasingly apparent. Outside the alternative sources of energy—solar, wind, tidal etc.—which are still not being given sufficient serious consideration at government level, the government's long-term plans make provision for coal and nuclear power to share most of the increased energy demand from the 1980s.

In a chapter entitled 'Coal and Coal Mining', Sir Andrew Bryan succinctly describes the formation of coal deposits. His fascinating account of the history of coal mining makes excellent use of old prints and photographs to illustrate coal extraction methods from mediaeval times to the present. The history of coal mining is an example of the popularity of a product and improvements in its production technology keep pace with each other. In the process, the demands upon human labour employed change dramatically. At the turn of the century the photographic record shows how miners suffered deformities from the arduous nature of their work. In contrast, the following chapter on the new mechanisation, by E. L. J. Potts, Dr. R. K. Dunham and John Scott, shows how improvements in technology have greatly improved these conditions of work. Far more attention is paid to safety, including a standard for the amount of dust allowable in the mine's atmosphere. At the same time, the number of miners employed in the industry has been reduced and a new workforce of technicians able to handle computers and advanced mechanisms is being created.

The discovery of the huge coalfield lying under Selby and district greatly widened the scope of coal production in this country. Michael Pollard's essay describes how the discovery was made and the problems posed for the NCB in planning the extraction of this treasure. Jeremy Bugler tackles the environmental problems that the community of Selby were confronted with. Although there is no suggestion of an 'environmental scandal' in this case, he does not hesitate to point out the deficiencies in the NCB's plans and their presentation to the people whose livelihood and heritage were at stake.

The final essay by W. T. Gunston shows that coal's new by-products are so varied and useful in application that once more coal can compete favourably with oil—a message in tune with the general tone of the book, one of approval for the industry as it exists today. Throughout, the text is lavishly illustrated with colour and B/W photographs, diagrams and prints. The presentation of a great deal of factual material is excellent, and the whole review can be read with enjoyment by energy specialists or laymen.

Health and Safety: Industrial Air Pollution 1975
HMSO. 70 pages. £2·00 plus postage.

In spite of the difficult financial position of works registered under the various Alkali regulations, much progress was being made on air pollution control and industry was spending a great deal of money for the future on this problem. This comment is made by Mr Frank Ireland, Chief Inspector of HM Alkali and Clean Air Inspectorate, in the Health and Safety Executive's report on industrial air pollution for 1975. Mr Ireland says that because of the economic situation there were many closures either of works or units and the inspectorate was approached by individual works, trade associations, or nationalised industries for a relaxation of requirements. "Naturally we had to treat these requests with great respect and understanding, looking at the national interests and choosing priorities," says Mr Ireland. "To waive our requirements completely would often have favoured the laggards and been unfair on those who had already complied. We could not accept a reduction in standards, but we did accept a longer implementation period where we felt that this was justified."

The report states that the total number of visits and inspections during 1975 was 14,526 compared with 13,647 in 1974, and out of this total 211 were to, or in connection

with, works not registered under the Act and 51 were concerned with radioactive emissions. A total of 70 infractions were recorded compared with 57 last year and two successful prosecutions were taken, along with one carried over from the previous year.

The Alkali Inspectorate had sponsored research on a number of subjects under a budget of approximately £60,000 and details are given of some of the work undertaken.

Work carried out by the inspectorate on behalf of the Secretary of State for the Environment and the Secretary of State for Wales relating to airborne emissions of radioactive materials is described. The progress being made towards achieving the inspectorate's target on the emission of vinyl chloride monomer is included and the report also details research being undertaken by the inspectorate and Warren Spring Laboratory in collaboration with industry on environmental monitoring for vinyl chloride monomer round factories making or using the material.

A plea is made that all vehicle exhausts should be pointed above the horizontal, even if only by a few degrees, to prevent avoidable pollution of the atmosphere through dust being blown into the air.

Dealing with problems concerning farming the report says: "In the light of a number of cases of damage to vegetation near chemical manure works, the inspectorate is getting information on a national scale about the strength of fluoride emissions, deposition on vegetation and effect on cattle in the vicinity."

This report is the first on the work of the Alkali Inspectorate since the formation of the Health and Safety Executive and the chief inspector comments on the much closer working relationship, especially in the field, with other inspectorates, the executive and the Scottish Industrial Pollution Inspectorate which now works as the executive's agency in its work on air pollution control. Illustrated with diagrams and photographs, it deals in detail with the work of the inspectorate in the various fields of registered works including: chemical and allied works under 18 industry sub-headings; metal industries under 11 sub-headings ranging from smelting works to uranium and zinc works; fuel industries such as electricity, gas and coke; other industries under six sub-headings. A separate report is included on the work of HM Industrial Pollution Inspectorate for Scotland.

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NEWS FROM THE DIVISIONS

NORTH WESTERN

At a meeting of the North West Division held at Daresbury, near Warrington, on the 20th January, 1977, two papers were presented dealing with the use of Ozone as a deodoriser.

The Chairman, C. D. Darley, F.R.S.H., M.A.P.H.I., Director of Housing and Environmental Health Department, Wirral Borough Council, introduced the speakers—Dr. M. R. Hillis, Research Officer of the Electricity Research Centre, Capenhurst, and Mr D. P. Potter of the Ministry of Agriculture, Fisheries and Food.

Dr. Hillis dealt with ' Production of Ozone and its use in odour control '. He presented, with the aid of slides, the various methods of Ozone production. The commercial production of Ozone, as a deodoriser at the source of the smell, is achieved by means of two generally accepted systems. The plate method derived from the scientific work of OTTO uses a series of plates at alternative high and low tensions into which a glass dielectric is placed which interrupts the arc and causes a violet columned glow through which air is caused to flow. Normally about 1% of the air is converted to Ozone. Viz.,

$$3O_2 \Leftrightarrow 2O_3$$

The amount of the conversion of oxygen in the air flow to Ozone depends on the energy used in the system. This has been the subject of research both in regard to applied voltage, changes in frequency of current and method of application.

The second method of production is the tube system. This has been the subject of a great amount of research and ingenuity. Mather and Platt Ltd. have been involved in the production of a commercially viable Ozoniser based on this system for deodorisation of smells. The use of more energy in the production of Ozone causes problems of heat evolution. This is counted by the use of earthed cooling water being allowed to act as an electrode. With the higher frequency Ozoniser smaller space is required and 1·5 K grams of Ozone per hour can be produced.

The oxidation of smells by Ozone has been used effectively in certain industrial processes but has not, as yet, gained universal application. The first principle is to capture the smells and treat them by:

(i) direct contact
(ii) scrubbing with Ozonised water
(iii) Ozone plus activated carbon
e.g. fish meal smells treated with Ozone in water and then through Ozoniser

The second paper "Potential Application of Ozone for Odour Control in the Fish Meal Industry" was presented by Mr D. P. Potter, H.S.O., Terry Research Station, Humber Laboratory, M.A.F.F. He spoke on the economics of fish meal production and its worth in the balance of payments and described its usual method of production.

He categorised the three sources from which smells were produced:

(a) open air storage
(b) cooking and venting of odours to atmosphere
(c) drying of meal.

The Ministry had researched into the effective use of Ozone as a deodoriser and had used a static dilution method to determine the response of a panel of people with varying olfactory sensitivities. The smell was extracted by use of a syringe from a part of the process. They had incorporated a system of air driers using Silica gel and filter before Ozonisation and had used varying scrubbers with water, caustic soda, hydrochloric acid, sulphuric acid, with or without Ozone, and had tabulated the results. The threshold dilution factors had shown an effective reduction of 91% using acid and Ozone and 89% with water and Ozone as opposed to 59% with acid scrubbing and 53% with water only scrubbing. He thought that this Ozone was relatively cheap to generate and that about 90% reduction of smell was possible by the use of Ozonisers.

The questions from the floor to both speakers ranged from the use of Ozone to control the smells of styrenes, amines, mercaptans and sulphides, to the cost of the purchase of a system and the running costs.

Both speakers thought that the use of Ozone to control styrene had not been evidenced and that mercaptans and sulphides were usually best incinerated. Obviously, from the application of Ozone in the fish meal industry, amines could be controlled as could animal by-product smells.

The cost given by a representative of Mather and Platt was thought to be about £7,000 per 1,000 cu metres per hour. A sewage installation costs about £8,000 with running cost £1·3—£1·7 per 1,000 gallons per hour.

The meeting closed with a vote of thanks from H. Corscadden, F.R.S.H., Chairman of the General Council of Environmental Health Officers Association (Knowsley Borough Council Environmental Health Department).

H. Roberts,
Principal E.H.O.
Wirral B.C.

NORTHERN

Fifty-five members attended a meeting held on the 11th February at the Civic Centre, Newcastle upon Tyne, when the main speaker was Mr. K. J. Verrill, Chairman of the Environmental Control Committee of the Asbestosis Research Council. Mr Verrill's talk ranged over the whole field and showed the numerous advantages possessed by asbestos, the precautions that can be taken to minimise the number of fibres that escape to atmosphere and the potential health hazards.

The discussion was opened by the Mr. F. G. Sugden, M.B.E., Chief Environmental Health Officer, Middlesbrough Borough Council, and a member of the Asbestos Advisory Committee. Mr. Sugden, after briefly describing the work of his Committee, recommended that each local authority should check its own installations for asbestos and ensure that when found it was in a sound condition and not likely to create a hazard. He also announced the publication of an Interim Report "Asbestos Health Hazards and Precautions" which he believed would be of considerable assistance to local authorities when members of the public requested advice.

C. R. Cresswell
Hon. Secretary

EAST MIDLANDS

The Headquarters building of the Production Engineering Research Association of Great Britain is situated in the pleasant Leicestershire market town of Melton Mowbray and is easily identified by the dominance of its six storeys over the immediate surroundings. At the top of a flight of stone steps, sturdy glazed doors open into a lofty and spacious assembly area. On 24th March 1977 a succession of arrivals into this area brought together 60 members of the Division to a meeting, in Melton Mowbray for the first time in the Division's history.

A lecture room providing excellent facilities had kindly been placed at our disposal by PERA, on whose behalf a welcome to members was extended by Mr. A. D. Hounslea, Senior Visitors' Liaison Officer. Response was made by the Divisional Chairman, Cllr. W. R. Cashmore.

After a short business meeting, Mr. Michael Williamson, Principal Environmental Health Officer for the City of Peterborough gave a paper entitled 'Noise in Relation to Current Legislation'. Mr. Williamson's paper was well received and provoked a lively discussion. It is hoped that the text will appear in Clean Air in due course.

Following the lunch break members reassembled for a talk by Mr. A. Lewney of PERA on the subject of noise generally and the involvement of PERA in this field. Mr. Lewney also dealt with a number of questions. Finally members were shown a film illustrating the activities of PERA.

From the film and from remarks by both Mr. Hounslea and Mr Lewney members learned that PERA is the largest research organisation in the country and has a worldwide membership. The Research and Development Services provided, cover a wide range of industrial applications including not only the provision and operation of plant, machinery and processes, but also matters like Production Plant Investment Appraisal, Industrial Photography, Computers and Noise/Vibration Control. In short, there would appear to be no part of the industrial field in which PERA is not active and able to offer advice and information.

At the end of the meeting a formal vote of thanks to PERA was moved by Mr. K. R. Enderby, City Environmental Health Officer for Peterborough and Vice-chairman of the Division.

E. F. Raven,
Hon. Secretary

WEST MIDLANDS

Mr. Charles Brookfield was elected Honorary Secretary at the Division's Annual General Meeting on 10th February 1977. Correspondence should be addressed to him at: Sandwell M.B., Environmental Health Department, Flash Road, Oldbury, West Midlands B69 4AE. Telephone: 021-552 3871. Mr Brookfield replaces Mr. D. A. Spurrier, who was elected Honorary Treasurer/Assistant Secretary.

DIARY OF EVENTS

16th June (Thursday)
The 30th Annual General Meeting of Yorkshire and Humberside Division.
Doncaster.
To be addressed by Mr. G. D. Edmunds, Clean Air Division, DoE.

22nd June (Wednesday)
Annual General Meeting of S. West Division.
Poole.

23rd June (Thursday)
Annual General Meeting of E. Midlands Division.
Peterborough.
Morning speaker: Mr. I. Holmes, High Peak.
Afternoon speaker: Mr. J. G. Thompson, DoE.

Annual General Meeting of W. Midlands Division.
Coventry.

6th July (Wednesday)
2 pm Annual General Meeting of the Society.
3 pm Installation of the President and Annual Public Meeting.
C.E.G.B. Lecture Theatre, Sudbury House, Newgate Street, London EC1.

26th July
Copy date for Autumn issue of 'Clean Air'.

19th-22nd September
44th Clean Air Conference.
Harrogate.

INTERNATIONAL NEWS

SOUTH AFRICA

The effect of a city on the environment is the subject of a long-term study recently launched in Pretoria by the C.S.I.R.'s Air Pollution Research Group (APRG). As part of the project, initially planned for a five-year period, accurate surveys will be conducted all over the city to determine exactly which pollutants occur, as well as the concentrations in which they are found. Information will also be collected on the temperature changes and other weather phenomena caused by a city such as Pretoria.

Pretoria was chosen because it is such a "difficult customer". Contributory factors are its geography and the siting of existing industrial and residential areas. Should the project be successful the results will have wide-ranging applications. It will enable the APRG to advise on the siting of industries and residential areas in other cities and towns to prevent the harmful effect of possible air pollution. Control measures are already in force against certain pollutants and the project will indicate how effective they are. In the case of certain other pollutants, sufficient information is not yet available on quantities and effects. The information gained during the project will provide the necessary background so that control measures can, if necessary, be introduced for these pollutants as well. The project is being sponsored by a number of industries (SASOL, A. E. & C. I., SAPPI and S.A. Cement Producers' Association) and is supported by the Department of Planning and the Environment.

UNITED STATES and CANADA

An anticipated 4,000 international authorities on air pollution control will attend the 70th annual conference and exhibition of the Air Pollution Control Association at the Sheraton Centre Hotel, Toronto, June 20-24 1977. The conference is the largest of its kind held annually in North America, comprising representatives from many sectors of industry, science, medicine and government. Founded in 1907 in dedication to the science of air pollution control, the organisation last chose Toronto for its convention site in 1965. More than 200 technical papers and panels will examine every facet of air pollution abatement. The conference will begin with a keynote session the afternoon of June 20 and continue daily until noon June 24. Companies and manufacturers from the United States, Canada and abroad will occupy 225 exhibition booths at the Sheraton Centre. They will demonstrate their latest technical innovations and equipment for collection, controlling, monitoring and analysing air pollutants.

THE ARGENTINE

A new municipal pollution control regulation, aimed at reducing the amount of soot in the air, states that incinerators currently used by residential buildings in Buenos Aires to dispose of domestic refuse must be replaced by refuse compressors within three years.

TURKEY

"Mass deaths" will occur unless urgent measures are taken to reduce air pollution, according to a report of the Association of Doctors and Chemists in Ankara. The SO_2 level is 2,252 $\mu g/m^3$—more than 37 times the limit of 60 $\mu g/m^3$ recommended for major cities by WHO. Ankara is situated on flat land surrounded by hills, and a cloud of thick, black smoke hangs over the city.

GREECE

Respiratory and heart disorders have increased by 17% in Piraeus, Greece's major port. A Local Authority committee discovered that smog was 35% higher than in many other industrial cities, and that SO_2 levels exceeded WHO standards.

JAPAN

Two exhaust gas desulphurisation plants have been put into operation at NKK's (Nippon Kokan) Fukuyama Works. One plant is designated for desulphurising coke oven gas from the works' No. 1 and No. 2 coke plants. Using the Takahax method, the equipment has a capacity of treating 130,000 Nm^3 gas per hour. The desulphurisation rate is 90%. The gas desulphurised by the equipment is re-used as fuel at various plants of the works. The sulphur extracted from the gas, combined with lime milk, is processed into gypsum. The gypsum produced, about 18,000 metric tons per year, is sold as material for construction.

The other plant desulphurises the exhaust from No. 3 sintering plant. It employs the NKK Ammonium-Ammonium Sulphate Method and has a treating capacity of 760,000 Nm^3 per hour. The capacity is the second largest for this type of equipment after the 1·12 million Nm^3/hour plant constructed at NKK's Ogishima Steelmaking Centre. Its desulphurisation rate is more than 90%. The sulphur is collected in the form of ammonium sulphate, which is produced at a rate of 20 tons per hour.

The Energy Show

A lake, complete with wave generating equipment, is to be be the centrepiece of The Energy Show, Olympia, September 8-18th, 1977. It will feature working models of government backed ideas being developed in the UK for tapping wave-power for electricity.

The Energy Show, sponsored by The Institute of Fuel, is to concentrate on all forms of energy—coal, oil, gas, electricity and nuclear—presenting for the first time in the UK a comprehensive picture of all major developments and potential in the production, distribution, efficient use and conservation of energy. It will also feature displays on wind, water and solar power, geothermal heat, tidal power, biomass fuels and other alternative and renewable sources of energy. A major section concerns itself with conservation, featuring proved and practical methods of decreasing fuel consumption in domestic, commercial and industrial buildings and processes, such as insulation and double glazing, as well as new ideas and inventions.

New ideas, in fact, are being deliberately encouraged by the Institute of Fuel and the show's organisers, Trident International Exhibitions Ltd. They are jointly devising a series of competitions, the results of which will be displayed in an inventions and innovations section along with invited displays of interesting international developments from research and academic institutions and private inventors. Some of these ideas will have displays of their own—such as methane and hydrogen vehicles and the electric bike, to be featured in a section on alternative fuel for transport.

Open University Course

The one-year Open University course, Environmental Control and Public Health, is again being offered to students in the 1978 session.

It is one of 34 courses in the University's Associate Student programme which is designed for adults wanting to broaden their educational experience. No formal educational qualifications are required for the course and, like all Open University courses, teaching is carried out through correspondence texts backed-up by television and radio programmes.

Environmental Control and Public Health is concerned with management of the limited natural resources of air, land and water. It covers the disposal of domestic and industrial wastes, the control of noise, and legislation related to major environmental problems.

The course is designed for those with a professional interest in the environment as well as for laymen who are concerned with current environmental issues.

Several home experiments are incorporated into the course and a home experiment kit will be sent to each student. The kit is designed to allow students to measure important parameters of water, air and noise pollution and to test concepts of the course in a practical manner.

The application period for Associate Student courses runs until mid-October, and applicants should apply to the Associate Student Central Office, The Open University, PO Box 76, Walter Hall, Milton Keynes MK7 6AN.

INDUSTRIAL NEWS

New Brink Mist Eliminator for Sulphuric Acid Industry

Enviro-Chem Systems, a wholly-owned subsidiary of Monsanto Company, has announced the development of a new, lower-priced, higher performance Brink mist eliminator, which can replace its high-velocity (HV) equipment in the sulphuric acid industry.

The new product, called Brink high-performance (HP) mist eliminator, is specifically designed to handle the particle size emissions typical to the sulphuric acid industry. The Brink HP has a significantly lower equipment and installation cost than the HV mist eliminator. In addition, it offers improved collection efficiency, is easier to install, requires less maintenance and is competitively priced.

The performance of the HP mist eliminator, which was developed to meet industry's demands for efficient, lower cost pollution control equipment, has been successfully demonstrated for more than a year on a 550 ton-per-day sulphuric acid plant, where collection efficiency of at least 95 per cent on particles from one to three microns in size was recorded. Cylindrical in shape, the element removes particles by trapping them in a chemically resistant fibre bed. Clean gases emerge from the bed while the material is collected and returned to the system. The Brink HP can for example be used in final towers to control air pollution.

Monsanto Enviro-Chem is in the process of confirming the performance of the Brink HP mist eliminator in other applications which may include fertilisers, organic incineration, Kraft paper, thermal processed phosphoric acid and miscellaneous organic mist emissions.

Reader Enquiry Service No. **7717**

Personal Sampling Kit for Airborne Asbestos Dust

A new kit containing all the equipment needed for on-site assessment of individual workers' exposure to airborne asbestos dust is available from C. F. Casella & Co Ltd. It allows factory inspectors or company safety officers to carry out several days' field work away from their base—perhaps checking a number of workshops, construction sites or repair yards where asbestos products are made, used or stripped out.

The kit is fitted into an executive-style briefcase and comprises: a Casella battery-powered pump-unit with aspiration rate adjustable from 10 ml/min to 2 l/min; a harness for wearing it; filter-holders for clipping to workers' lapels; connecting tubing, flow-meters and a pulsation-damper; boxes of Millipore membrane filters of 0·8 μm and 5 μm pore-size; a battery-charger and spare battery; and a stand for static sampling. Space for paper work and exposed filters is provided.

Because asbestos particles are fibrous there is at present no accurate way of isolating those that reach and can damage lung tissue—the 'respirable fraction'. The accepted sampling technique, therefore, is to collect onto a filter disc all the dust from a known volume of air, then to count the fibres of interest using a microscope. These are generally agreed to be particles more than 5 μm long, less than 3 μm diameter, and with length at least three times diameter. To avoid purchasing a microscope and training staff, exposed filters are commonly sent away to commercial laboratories for counting.

Worldwide standards defining acceptable limits for airborne asbestos concentrations have been generally agreed, and in most countries backed by legislation. Normal limits are 0·2 fibre/ml for crocidolite (blue asbestos), considered especially dangerous, and 2 fibres/ml for other forms. Respirators and protective clothing must be worn if exhaust ventilation cannot maintain concentrations below these limits.

Dust concentration may vary greatly within a workshop, and personal sampling, with a sample intake placed within 30 cm of the worker's nose accompanying him as he moves about, is the only accurate means of assessing the hazard associated with an individual job. Casella personal samplers are already used to assess exposures to many atmospheric contaminants, including gases, mists, dusts and radioactive particles.

Excessive exposure to asbestos dust can cause asbestosis, lung cancer or mesothelioma, sometimes many years later. Manufacturers of asbestos products are well aware of the dangers, and use samplers mainly for regular checks of ventilation measures. Greater risks may be faced by workers exposed to asbestos dust only intermittently, possibly not even recognising it: building workers trimming insulation board; contractors lagging or de-lagging generating plant, furnaces, and ships' engines; even garage mechanics repairing brakes and clutches.

Normal practice is first to take a 10-minute sample at high aspiration rate—say 2 l/min. If the average concentration is less than 2 fibres per ml the level is acceptably low. If the concentration is more than 2 but not more than 12 fibres/ml then further sampling should be carried out over a four-hour period at, say, 20 ml/min. The pump will run 8 hours on one charge.

Reader Enquiry Service No. **7718**

International Coal Combustion Project

Orders for major items of equipment are announced by NCB (IEA Services) Ltd for construction of the pressurised fluidised bed coal combustion plant to be built at Grimethorpe near Barnsley, South Yorkshire.

NCB (IEA Services) Ltd is a wholly-owned National Coal Board subsidiary company acting as operating agent on behalf of the three countries collaborating under an International Energy Agency Agreement in the £17 million project—the USA (Energy Research and Development Administration), W. Germany (Kernforschungsanlage Julich) and the UK (National Coal Board). The design phase of the programme is now virtually complete, agreement has been reached on proceding to the construction stage, and some fabrication and preliminary site work is now under way.

The compressor, worth about £1·4 million, has already been placed on order with a British company, Compair Industrial Ltd of Ipswich, who have sub-contracted the steam turbine to GEC. The combustor unit,

worth about £2 million, will be provided by the German firm, Vereinigte Kesselwerke A.G. of Dusseldorf and incorporates coalfeeding equipment to be supplied by the American firm, Petrocarb Inc. of New York. Exhaust gas plant worth about £1·5 million will be provided by the British firm, Head Wrightson Process Engineering Ltd of Thornaby.

The total estimated cost of the project, of £17 million at present prices, includes construction and the cost of a three-year experimental programme. The capital expenditure element is estimated at over £9 million and the remaining capital contracts and the buildings are expected to be placed in the near future mainly with British firms.

The plant will have a thermal capacity of 80 Mw and will consume upwards of 10 tons of coal an hour. It is intended to provide experimental facilities for combustion, heat transfer, gas clean-up and energy recovery in pressurised fluidised bed combustion systems, the advantages of which are in compact plant for power generation and industrial coal burning, lower cost, higher efficiency and environmental advantage over existing systems. Data from the experiments will assist the engineering of future developments in the three project-member countries.

The National Coal Board, who had already undertaken a considerable amount of research on fluidised bed combustion systems, offered the Grimethorpe site when the decision in principle to launch the present project was agreed in 1975.

Reader Enquiry Service No. **7719**

Motorway Pollution Survey

"I wonder what difference the new motorway will make to my home." So said Mr Terry Ryan, Head of the Construction and Urban Studies department of Preston Polytechnic in January 1975. That chance remark has led to Arkon Instruments Ltd being involved in a fascinating study of motorway pollution.

Mr Ryan's home is in the countryside north of Preston. He had just seen the plans for the M55 motorway which, in linking Blackpool with the M6, passes within 400 metres of his home. The man to whom the remark was made was John Tinker, a lecturer at the Polytechnic, who realised that here was a first class opportunity for a major study.

Motorways are continuously polluted with rubber from tyres, oil and exhaust fumes from engines. What happens to it? where does it go? and in what quantities? John Tinker, in conjunction with the Chemistry department of the Polytechnic and Pollution Research Unit of Manchester University, spent the following seven months organising a monitoring and analysis installation adjacent to the motorway site. Timing of the project allowed John and his team to test and analyse water and soil, prior to the motorway construction, during construction and since the motorway opened in July 1975.

The small, well equipped testing station is positioned directly over one of the main drains. An Arkon 'V' notch weir has been fitted into the drain and connected to an Arkon flow recorder. During rain storms, the recorder is automatically switched on and a moving pen and graph accurately record the amount of water draining from the motorway. While the recorder is in operation samples of the water are taken at five minute intervals. These samples are taken to the Polytechnic, where they are analysed for selected pollutants and suspended solids. The tests and resultant analysis show the amount and type of pollutants in a recorded quantity of drained water.

From the motorway, the water drains into a nearby stream which, in turn, drains into a closed canal. By natural seepage, the canal drains into the surrounding countryside. Preston and Blackpool take their normal water supply from the Lake District which is 25 miles north of the area. During the peak summer months, when the normal supply is insufficient, extra water is drawn from boreholes in the vicinity of the canal.

Tests and analyses will continue for a further three years, so John Tinker feels it is too early to make predictions. It is to be hoped that the Arkon application will contribute to a report that shows 'there is no need for concern'.

Reader Enquiry Service No. **7720**

Volvo Wins Award for Emission Control

Volvo has received the U.S. National Environmental Industries Council award for excellence in air pollution control. The award recognises Volvo's contribution to automobile emission control technology with its new Lambda-Sond three-way catalytic converter system.

The new Volvo system was chosen from among dozens of applicants in the air pollution control category. The award certificate cites the company's outstanding leadership in the application of advance environmental technology and major contribution to protection of the nation's environment, and is co-signed by the President's Council on Environmental Quality.

The Lambda-Sond system is the first to incorporate an oxygen feedback loop and a catalytic converter which controls all three regulated exhaust pollutants; hydrocarbons, carbon monoxide and oxides of nitrogen. The key to the system is the sond or sensor which reads the oxygen content of the exhaust and sends electrical impulses to a mini computer to maintain very tight control of the air/fuel mixture.

The system was designed to meet California's stringent 1977 emission standards while providing improved fuel economy over more complex systems that incorporate air pumps and exhaust gas recirculation. Lambda-Sond achieved its design goals by wide margins.

Reader Enquiry Service No. **7721**

New Boiler Saves Heat and Waste Bills

A smoke-free boiler which could save up to £35,000 a year on heating and waste disposal bills has been installed by Jaycee Furniture Ltd at their Woodingdean, Brighton factory.

The new facility cost over £180,000, including the boiler house. It disposes of all Jaycee's wood waste (formerly taken away by a refuse company) and will eventually be used to heat the entire 140,000 square-feet factory. Previously, less than half the factory was heated inadequately. In addition, better combustion of the new boiler solves air pollution problems.

The boiler is made by Gerrard Hare Ltd. It has a separate furnace and burns about one ton of wood waste per hour. All types of wood waste can be handled, ranging from large pieces broken down in the hogger to sander dust. The boiler produces 10,000 lbs of steam per hour at 100 psi, sufficient for heating and process steam requirements. In summer months, when less heating is required, steam can be converted back to water in varying degrees to suit demand.

In the future, the boiler may be used to produce a third of the electrical power required at Woodingdean by changing to 350 psi and adding a generator. Jaycee will be installing a similar boiler system at their new Eastbourne factory, due for completion in July.

Reader Enquiry Service No. **7722**

Chloride to build battery buses in America

Chloride Incorporated has concluded an agreement with Electric Vehicle Associates (EVA) of Cleveland Ohio, to manufacture and sell electric buses and vans in the USA.

EVA has established itself as a pioneer in the electric vehicle business in the USA. Formed in 1974, it has supplied electric cars for federal, state and municipal customers. Some 18 months ago, it purchased the electric vehicle division of Otis which added bus and van capability.

The bus and van division of EVA will be transferred to a new 50/50 company to be known as EVA-Chloride. The consideration made by Chloride is less than 1% of the Group's assets. Announcing the agreement, Mr James Gilchrist, managing director of Chloride America, said that, "We are certain that the electric bus and van are commercially feasible and adaptable to the United States market. Those electric buses currently in operation are proving that they can offer dependable and economic service. The Silent Rider, an electric bus developed by Chloride in England, is in daily use in Manchester and the Silent Karrier, an electric van, has been in daily usage in Birmingham. EVA also has design rights on buses and vans which are presently in operation in the US. With the combined experience of EVA and Chloride, we shall develop vehicles which will represent the latest in design and efficiency."

The EVA-Chloride Electrobus is a tried and tested vehicle, and buses are already in operation at Long Beach, California; Roosevelt Island, New York; Rochester, New York. Five more buses are scheduled to be delivered shortly.

Electrobus operates on a 72 volt battery and can average 65 miles on one charge. It has a speed of 32 mph and can carry 35 passengers. EVA-Chloride will also market an electric van which can handle a payload of 500 lbs. With a range of some 40 miles on one charge, it is particularly well suited for city centre deliveries.

Formation of the new company was announced at the opening of the Chicago Electric Vehicle Exposition, where it was also announced that EVA-Chloride is in discussion with the Energy Research and Development Administration for a research grant. Under the Electric Vehicle Research and Development Act, passed in 1976, the US Government can spend up to $160 million in grants to private industry for research and development of electric vehicles. EVA already has three vehicles being tested by ERDA in Washington.

Reader Enquiry Service No. **7723**

Disposing of a Nuclear Problem

At Hinkley Point in Somerset a specially designed Wellman Incandescent incinerator has been commissioned to deal with a wide range of contaminated waste and waste oil arising from the Central Electricity Generating Board nuclear power station.

This new unit, which is believed to be the most advanced of its kind in the world, was exhaustively tested in lengthy field trials before being used on active contaminated waste. To meet the C.E.G.B. rigid safety standards and environmental requirements the plant has 27 sensing devices which continuously monitor important operating parameters. Deviation of any of these from the normal setting instigates visible and audible alarms and depending on the nature of the alarm condition, causes various levels of automatic shut-down including complete stoppage of the plant.

The waste material is burned and gases are repeatedly cleaned to remove radioactive and other pollutants. The unit is especially equipped to contain completely the waste and residues. These are extracted in a sealed system. The whole plant is designed to ensure the safe disposal of nuclear waste to C.E.G.B. standards which more than fulfil the requirements of UK legislation.

It is expected that this new line of equipment developed by Wellman Incandescent will be of considerable interest to other nations employing nuclear power generation.

Reader Enquiry Service No. **7724**

New carbon 'most effective known' for odour control

Chemviron, Europe's largest producer of granular activated carbon, has introduced a new vapour phase carbon which is said to be the most effective material known for removing pungent hydrogen sulphide and other odorous gases from the environment.

The new IVP Granular Activated Carbon has more than double the capacity of similar materials for adsorbing hydrogen sulphide, as well as 50% more capacity for methyl mercaptan gases—the main causes of odour in sewage treatment plants and such industries as pulp and paper mills, petroleum refineries and chemical plants.

In tests on a vacuum filter exhaust in a sewage treatment plant, where levels of hydrogen sulphide varied from 1-40 ppm, a six-inch bed of IVP completely removed the gas for a period of more than 50 days without having to be replaced.

In further experiments, the new carbon was exposed to a moist air stream containing 1% hydrogen sulphide and a 20-25% loading, by weight of carbon, was obtained—compared to only 9·5 wt % when using a standard vapour phase carbon.

Chemviron manufactures a range of high-grade carbons, which are used for in-process purification, potable water treatment, or the treatment of industrial and municipal wastewaters, as well as odour control. A leading specialist in the concept of using carbon adsorption technology for the control of air and water pollution, the company will also help in the design of equipment for removing odours, or for extracting toxic and non-toxic organic matter from effluent.

Reader Enquiry Service No. **7725**

Fixed installation continuous toxic gas analysers

Following the recent introduction of their range of Portable Toxic Gas Analysers, Detection Instruments Ltd. are now offering the LD Series of Continuous Toxic Gas Analysers for carbon monoxide, sulphur dioxide, hydrogen sulphide, nitrogen dioxide and chlorine.

The LD Series use basically the same sensing and electronics methods as the portable models but have been designed to operate on mains AC power. The units are packaged in thermostatically - controlled NEMA type enclosures, which are available to three different specifications:

NEMA 4: protects the equipment against splashing water, seepage of water, falling of hose-directed water, severe external condensation, dust and dirt.

NEMA 4X: as NEMA 4, but also corrosion-resistant.

NEMA 12: intended for indoor use and protects the equipment against fibres, flyings, lint, dust and dirt, light splashing, seepage, dripping and external condensation of non-corrosive liquids.

All LD Series units are suitable for wall-mounting and are normally provided with audible and visual alarms. The alarm set point is continuously adjustable throughout the full-scale range of the analyser, with the audible alarm function being volume adjustable and inhibitable. The sample is drawn by an integral diaphragm pump, controlled at a rotameter. The pump is installed down-stream of the sensor, eliminating the possibility of pump-caused sample contamination or absorption. All gas connections to the system from the outside are by bulkhead unions and the enclosure door is provided with a window to allow inspection of the analyser's panel meter, the rotameter and certain optional indicating lights. All LD sys-

tems are equipped with a folding handle.

Options available are:

* clogged filter indication via integral vacuum switch
* output to recorder
* relay contacts
* remote alarm indication
* multiple sampling inputs via stream switching or new continuously on-line multipoint technique
* special packaging
* all TFE aspirator (in lieu of pump)

Reader Enquiry Service No. **7726**

New range of automatic liquid samplers

Arkon Instruments Ltd claim that their range of vacuum operated, discrete interval samplers should prove invaluable where the sites are remote, in flameproof zones, or likely to be corrosive.

Local and regional water authorities and industrial establishments who have a necessity to monitor pollution will find the samplers of great benefit. Their reliability and portability are of great advantage for 'site' sampling and subsequent analysis of sewers, rivers and streams.

The units are ideal for operation in adverse environmental conditions, claim the company. In addition, the extensive choice of sampling intervals offered as standard, gives the user considerable flexibility in planning the sampling programme.

Four units are available, giving a choice of 12 or 24 bottles which can be either half or full litre capacity. All models are housed in totally enclosed, spun light alloy containers fitted with lockable toggle catches and lifting handles. The samplers are prepared for use by creating a vacuum in the bottles by connection to either an electrically driven or hand operated pump. Each bottle is then locked off by the manual closure of pinch valves.

Specially formulated silicone rubber is used for the pinch valves and seals. It has the advantage of requiring a low closure force, providing an excellent seal and retaining its elasticity over a wide temperature range. After the bottles have been locked off, a multi-tube hose is attached to the sampler inlet manifold connecting each bottle separately to the sample source.

The valves are opened sequentially by a time controller driving a valve release trigger, thus allowing a 'sample' to be drawn into each bottle at pre-selected intervals. The clock which controls the frequency at which the samples are taken is sealed to prevent the ingress of moisture, which allows the sampler to be used in corrosive or humid conditions.

To ensure a constant torque on the sampler mechanism, a separate stainless steel tensator motor is used. It permits the release force of the triggers to be greater than if driven by the clock and results in fewer problems.

A novel system of 10 interchangeable gear boxes gives a choice of 10 sampling intervals. Two are supplied as standard, the other eight being available as optional extras. Depending on which gearbox is used a maximum delay of from six to 288 hours can be set before sampling commences.

Vacuum operated samplers developed over the last 10 years have established a high reputation in the field of pollution control.

Reader Enquiry Service No. **7727**

Energy Equipment to Convert Water-Tube Boiler to Fluid-Bed Combustion

Placing of a contract with Energy Equipment by Cadburys for the conversion to fluidised-bed combustion of a 30,000 lb/hr John Thompson water-tube coal-burning boiler at its Bournville complex represents a further significant advance in fluid-bed technology. Understood to be the first commercial application in the world of an atmospheric fluid bed to a conventional water-tube boiler, the total cost of the conversion equipment will be in the neighbourhood of £70,000.

Energy Equipment's fluidised-bed combustor, however, is designed so that it can burn the cheapest grades of coal. Furthermore, compared with a conventional chain-grate stoker, combustion efficiency is considerably improved, excess air being reduced from some 50-70 per cent to as little as 10 per cent with a CO_2 content in waste gases of 14½ per cent. As a result of these factors, dramatic savings in running costs, estimated at some £44,000 per annum, will be made and the capital cost of the conversion recovered in less than two years.

At present the boiler is fitted with a chain-grate stoker and this will be replaced by a standard Energy Equipment fluid-bed combustor designed to release 51 million BThU per hour. The bed area will be 70 sq ft and this will be divided into twin zones each with its own trim heater. Modifications will be made to the boiler water wall so that the wall tubes can be used to give a submerged in-bed heat exchange of approximately 8 million BThU. Commercial grade sand will be used as the bed medium and means will be provided for automatic bed levelling and sand cycling for ash removal.

Reader Enquiry Service No. **7728**

Tanktector Reveals Damage to Internal Linings Before Leaks Develop

Usually the first indication that a fault has developed in the lining of a chemical tank is when the chemical leaks, or sprays, through the outer skin. Besides the severe hazard, the chemical has by then been contaminated which can be most costly.

Elcometer Instruments Ltd have therefore introduced an improved production 'Tanktector' instrument which reveals the presence of internal lining flaws immediately they develop.

The Tanktector is designed for the detection of cracks or holes in non-conductive linings of steel tanks or vessels containing corrosive liquids. A major feature is that tests are undertaken while the contents are still in the tank. This reduces the need for time-consuming and, therefore, costly shutdown periods for the tanks to be emptied for visual inspection. The Tanktector power source is current from the electrolytic action of the corrosive liquid into which it has been placed and the two integral electrodes which form part of the instrument's body.

The device is suitable for use in mild steel vessels which contain metallic components other than mild steel in contact with both the contents and the vessel's outer shell.

Lining failure is indicated on a compact meter housed in a protected panel with two other simple-to-operate controls. Alarm lights and sirens can also be triggered. It is of tubular construction (2½ in diameter with a range of lengths) and is simply inserted through a suspect tank's inspection cover or other access point. Application is not limited to static installations but can be used on mobile vessels whether transported by road or rail.

Reader Enquiry Service No. **7729**

CLEAN AIR

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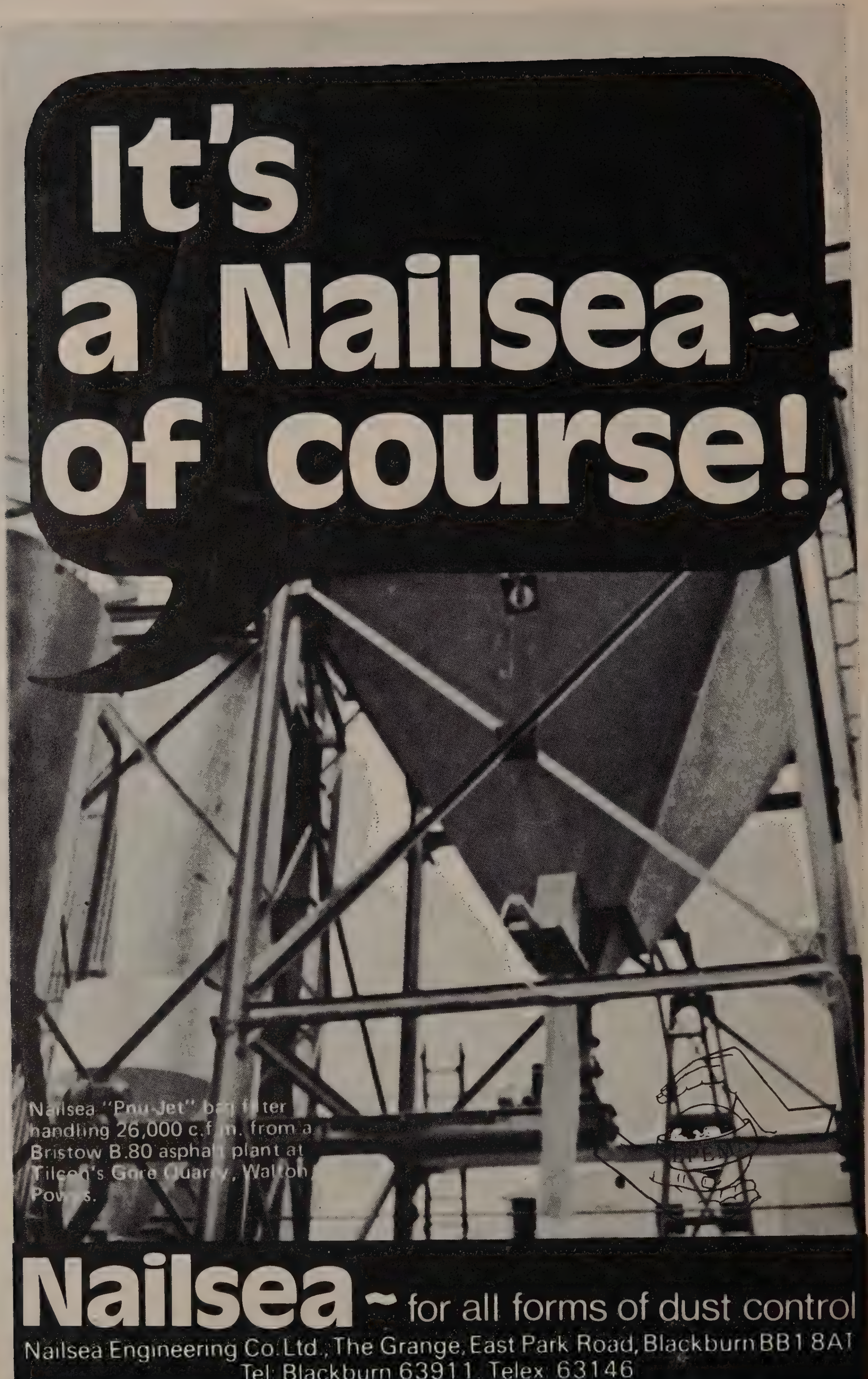
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CLEAN AIR

AUTUMN 1977
VOL. 7 NO. 26

CLEAN AIR

THE JOURNAL OF THE NATIONAL SOCIETY FOR CLEAN AIR

Vol. 7 No. 26 **Autumn 1977**

Clean Air's Jubilee

In this Jubilee Year we would do well to remember that 5th December, 1977, will be the 25th anniversary of the great London smog of 1952. No-one would wish to celebrate the 25th anniversary of that smog responsible as it was for the deaths of over 4,000 people; but we have every right to remember that the smog was the catalyst which led to the appointment of the Beaver Committee, the publishing of the Beaver Report and the passing of the Clean Air Act in 1956 which has resulted in a period of 21 years in which the air has become cleaner every day. This achievement of cleaner air is something to celebrate; the anniversary of the smog is not.

Although many reading this will remember the smog quite well, there are millions now growing up who do not and who have been able to grow up in cleaner air and in a cleaner environment. It is right that all should grow up breathing clean air and that this should be their heritage. To those of us who remember the smog and what our air was like before the passing of the Clean Air Act our duty is quite clear. It is to ensure that the rising generation realise the benefits under which they have grown up and that it is now becoming their responsibility to see that the air remains clean for future generations.

On November 5th each year we celebrate the Gunpowder Plot with fireworks and bonfires, to some a negation of clean air. Perhaps after all there might be something to be said for remembering the 5th December—but not celebrating it—as a day on which something happened which is our avowed intention shall never occur again and a day which led to our clean air legislation. Since that time the achievement of cleaner air has had its ups and downs, and the last two years have been one of the downs. However, the moratorium on the bringing of new smoke control orders into operation has now passed, and as the figures in another part of this journal show, there has been a welcome fillip to progress in smoke control. At a time of financial restraint it is only fair that efforts to improve the environment should be seen in perspective and like everything else have priorities established for them. But it has long been recognised that smoke control is not only the most effective but also the cheapest method of achieving cleaner air.

So let us remember the 5th December and celebrate the end of smog by doing all in our power to persuade those responsible to press on with the smoke control programme throughout the country.

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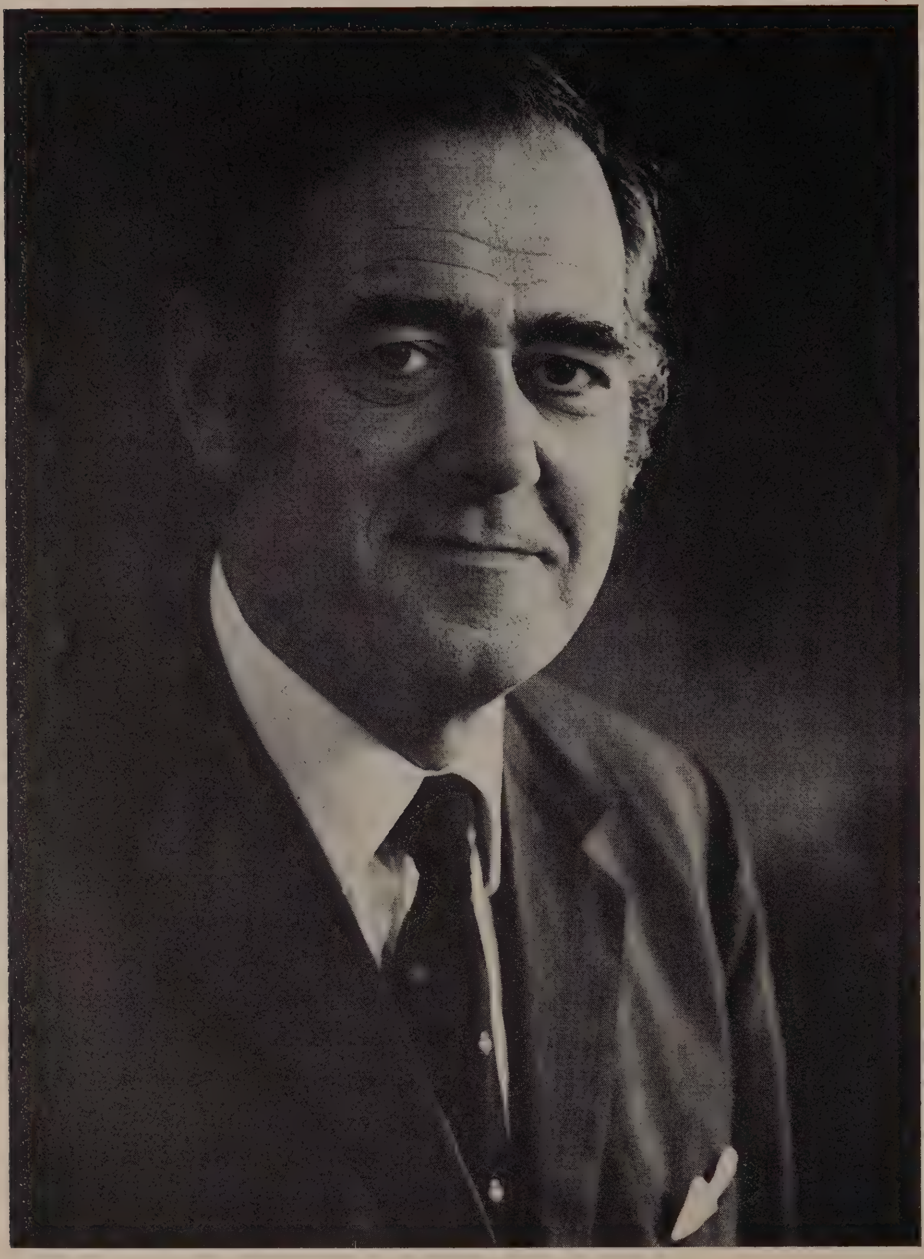
The Society's New President



Sir Brian Flowers, FRS, was educated at Swansea, Gonville and Caius College, Cambridge, and at the University of Birmingham. From 1944-46 he was engaged on the atomic energy project at Chalk River, Canada, and did research on nuclear physics at the AERE, Harwell, from 1946-50. After a short spell in the Department of Mathematical Physics at Birmingham University he returned to Harwell in 1952 as Head of the Theoretical Physics Division and was appointed Chief Research Scientist in 1958. In the same year he became Professor of Theoretical Physics at Manchester University and from 1961 until September 1972 he was Langworthy Professor. From 1966 to 1970 he was Chairman of the Computer Board for Universities and Research Councils. In 1967 he was appointed Chairman of the Science Research Council. He was President of the Institute of Physics from 1972 to 1974. He became Rector of Imperial College of Science and Technology on October 1st 1973, and was Chairman of the Royal Commission on Environmental Pollution from 1974 until September 1976. In November 1974 he was elected President of the European Science Foundation at a meeting of the ESF's Founding Committee in Strasbourg, and, in 1976 was re-elected for a further two years.

The Annual General Meeting

The Society's Annual General Meeting was held on Wednesday 6th July at the C.E.G.B. Theatre, Sudbury House, Newgate Street, London, EC1. About 50 members and representatives were present.

Mr R. A. W. Hollingdale, Honorary Treasurer, in presenting the financial statement for the year ending 31st March 1976, was able to report that a loss of some £7,000 the previous year, because of economies and other efforts made, had been turned into a net gain in trading of roughly £1,000. Nevertheless, it had been considered prudent to ask for a small increase in subscriptions this year and this had been approved at an Extraordinary General Meeting held in Edinburgh in October last.

The Chairman then moved the adoption of an Ordinary Resolution that the Bye laws of the Society should be amended to increase subscriptions to the Society by some 10 per cent to keep pace with inflation and rising costs. This motion was carried unanimously.

Mr Philip Draper, Chairman of Council, in moving adoption of his report, said that as this had been circulated to all members he wished to mention only a few salient points. He drew attention to the tremendous amount of work which had been achieved by the headquarters staff and the continuing hard work of the Committees. As regards events of particular note, one could not overlook the lack of progress in smoke control; on the other hand it was gratifying that most of the provisions of the 1974 Control of Pollution Act were now being brought into force. The Chairman commended the Seminars organised by the Society as he felt that they dealt with specific subjects and were of tremendous value to all those who attended them. Finally, Mr Draper thanked the Honorary Treasurer and his financial advisers, the auditors, for the work which they had undertaken so ably on behalf of the Society.

Professor Scorer then commented on the Society's work with the Clean Air Council. The Chairman's report had stated that 'The Society continued to have good representation amongst the membership of the Clean Air Council and indeed, the Chairmen of three Committees of the Council were provided from within the ranks of the Society.' Professor Scorer said he wished to inform members that it went further than that because the Society carried out a very important role in briefing the lay members of the Clean Air Council; the work of the Society was very effective indeed.

Mr R. A. W. Hollingdale was re-elected as Honorary Treasurer for the ensuing year and Messrs George, Little, Sebire and Co. were re-appointed as auditors.

The meeting then proceeded to elect Sir Brian Flowers, FRS, as President in succession to Professor P. J. Lawther.

Professor Lawther, introducing his successor, said that during his term of office he had endeavoured to do what

Professor Lawther congratulates his successor, Sir Brian Flowers

he could to help the work of the Society but was not quite clear that he had achieved very much. However, he had, he hoped, 'bowled at the nets' to the benefit of the Society and its members. He then introduced Sir Brian Flowers and presented a brief biography of Sir Brian's many achievements. Professor Lawther said that undoubtedly these many achievements and Sir Brian's distinguished career had been grooming for the high office of President of the National Society for Clean Air. Sir Brian thanked Professor Lawther for his kind introduction and said that he recognised the great importance of the Society and its many achievements over the years. It was a Society that was well respected, not only by 'crackpots' but also by government itself and all people in responsible positions.

Sir Brian was then invested with his Chain of Office by Professor Lawther, and Mr T. H. Iddison, on behalf of all members of the Society, moved a vote of thanks to Professor Lawther who had served the Society not only very faithfully but also very effectively during his term of office.

The Business Meeting was followed by the Public Meeting which was addressed by Sir Brian. His address entitled 'HMPI in Wonderland, and Other Vexations' is published overleaf.

HMPI in Wonderland and Other Vexations

Sir Brian Flowers, FRS

Presidential Address to the NSCA Public Meeting, 6th July 1977

When I first realised that I might be expected to speak to you today I imagined that it would be easy to choose the topic. The Royal Commission's Fifth Report on air pollution control appeared in January 1976: 18 months later there would clearly have been a Government response, and I would respond today to that response, hopefully complimenting the Government on having been so sensible as to accept most of our recommendations, and gently upbraiding them for postponing considerations of the rest pending closer study. Alas, it was not to be; there has been no response, although it has been imminent for some months past. This is my First Vexation.

This is not to say that there has been no action at all. As the Society knows, the Department of the Environment have invited views on the two consultation documents drawn up to test opinion on two of the Royal Commission's major recommendations—the proposal to absorb the Alkali Inspectorate into a unified inspectorate, HMPI, responsible to the Secretary of State for the Environment, and the proposal to introduce air quality guidelines in order to judge whether the practice of the best practicable means is leading to reasonable results. I am glad that on these and other matters the Society has submitted its views.

As time slips by, however, issues become less clear and misunderstandings arise. For instance, it is often said that HMPI might interfere with the prerogatives of the Alkali Inspectorate. How could it when it would *contain* the Alkali Inspectorate? Or that it might impinge upon the responsibilities of the environmental health officers. How so, when its statutory duties would be confined to the arisings of pollutants in the small minority of processes scheduled as being technologically too difficult for the local authorities to handle? Or that it might undermine the work of the water authorities. But they were carefully left responsible for everything they do now, including the setting of water quality and the detailed control of the vast majority of polluting effluents. These objections are really paper tigers which do not seem to me to bear much relation to the actual proposals. Some of them, I have little doubt, arise from the poor regard which local authorities have for central government, and I suppose they have their reasons! Indeed, it was to anticipate that reaction that we made additional proposals concerning public accountability of the central inspectorate and the desirability of their sharing their responsibilities with local authorities.

On what does the cause for HMPI really rely? Firstly, as I have already implied, on the conviction that as far ahead as we could see there would continue to be a need for a national authority to deal with technologically difficult processes. Secondly, on the fact that the ultimate source of pollution is a process which in general pollutes water and land as well as air, and that pollution can be transferred from one form to another by modification to the process and to the treatment given its various discharges. Thirdly, that air pollution control in this country owes its success very largely to the application of best practicable means, especially in the control of novel and difficult processes where it would not be practicable simply to set emission standards.

"The essence of the matter," we said, "is the Alkali Inspectorate's understanding of the technology of industrial processes. It is this knowledge that enables the Inspectorate to maintain effective pressure on industry for improved standards, for to be effective their requirements must be realistic in technological terms; it is this knowledge which qualifies the Inspectorate to become involved in industry in the design of new plant, thus ensuring that arrangements to control air pollution are considered as an integral part of design. Our main concern is that the same technological knowledge and techniques should be brought to bear on the problems which arise in dealing with pollution in other forms."

In short, we wished to see the concept of best practicable means applied to all forms of pollution arising from a given technological process, in such a way as to cause least environmental damage overall; an idea we tried to convey through the phrase "best practicable environmental option". It seemed to us clear that, at least in the case of novel and difficult processes, the best practicable environmental option required a unified body, albeit one based largely upon the existing strengths of the Alkali Inspectorate, and that mere consultation between a number of authorities individually responsible for the different forms of pollution was most unlikely to be sufficient. After all, that could have taken place a long time ago; but it did not: the various authorities, with some honourable exceptions, were more interested in independence than in co-operation. Equally futile, in my view, would be a body which had purely advisory or consultative powers, for in that case there would be nowhere the experience of establishing best practicable environmental option could build up. What is needed is executive experience in the field, not disinterested technical and legal advice bereft of the experience that can only result from having been responsible.

There is a tendency in Government nowadays to replace proposals for executive bodies by advisory committees. A committee is cheaper, I suppose; but as Sir Barnett Cocks, the former Clerk to the House of Commons, once said: "A committee is a cul-de-sac down which ideas are lured and then quietly strangled." So let us have HMPI, let it be active in the field, and let it bring about best practicable environmental options without vexatious delay. And lest we are led by disbelievers to doubt the possibility of introducing HMPI, let us remember that we have proposed is little more than what has existed in Scotland for a long time—the Industrial Pollution Inspectorate.

The Royal Commission also made a case for the introduction of air quality guidelines. We did not wish to see the imposition of emission standards because even though they might be fair to the polluter they would manifestly be unfair to the polluted, because the degree of pollution produced by a given emission depends on local circumstances. On the other hand we did not agree that air quality standards could be effective as a means of control, for a variety of reasons we spelt out in detail, such as the difficulty in distinguishing between the effects of several different sources: indeed we regarded this approach as neither practicable nor desirable. We pointed out that

"bpm" is the control of *emissions* with the object of achieving an acceptable level of air quality. To see whether the control mechanism is effective enough to give an acceptable environment without placing quite unnecessary burdens on industry one must therefore have some idea of the air quality that it is desirable to achieve. We proposed the introduction of air quality *guidelines* to enable such judgments to be made, and to be *seen* to be made.

Much confusion arises if one does not realise that the control of emissions is the *means* of air pollution control, not the *aim*, and that the achievement of an acceptable level of air quality is the aim, not the means. At the time our proposals were made the British concept of "bpm" seemed to be in conflict with the approach adopted by other European countries, and this is my Second Vexation. I like to think we may have helped to bring about a reconciliation of views. According to the DoE Consultation paper I have already referred to: "The Royal Commission refer to the European Economic Community and air pollution control and indicate some reservations about the Community's proposals to establish air quality standards. Since the Royal Commission's Report was prepared more information has emerged about the Community's proposals which envisage objectives to be reached rather than rigid standards with a penalty for non-compliance. The Community's proposals indicate dates by which member States are required to take the necessary action to achieve specific ground level concentrations for certain types of pollutant. In the Department of the Environment's view the concept as now envisaged by the EEC is close to the Royal Commission's concept of guidelines. Both lay emphasis upon the importance of a framework to guide those who have to decide what emissions will be acceptable in particular cases in order to limit or reduce ground level concentrations."

Let us therefore hope that we are not too far from removing an unfortunate source of friction between ourselves and our partners in Europe, which arose due to an insufficiently precise analysis of the realities of air pollution control on both sides of the English Channel. I am sure the Society can help here, and I am glad you have the matter under review.

Although initial attention has naturally been concentrated on these two matters—HMPI and air quality guidelines—the Royal Commission devoted a chapter to the very important subject of domestic smoke control. We began that chapter as follows: "Smoke in conjunction with sulphur dioxide is damaging to health. In 1952, at the time of the great smog in London, about 43% of the smoke and 18% of the SO_2 in the air in the UK came from the chimneys of houses. These domestic emissions provided the main constituents of the smog. Today, the total amount of smoke in the air has been reduced by some 80%, but industrial emissions have been so far reduced that over 90% of the smoke (but a much smaller proportion of the SO_2) emissions still come from houses. The effect of domestic pollution is even greater than these figures suggest. Domestic smoke, emitted slowly and at a low level, causes high local concentrations whereas emissions from industry are normally widely dispersed through tall chimneys. Domestic emissions therefore still constitute a major air pollution problem."

We noted the development of smoke control zones since the Beaver Committee recommendations of 1953. "Where smoke control has been introduced the improvement in the quality of the air has been dramatic . . . The most important effect has been the reduction in acute effects on health." But in spite of overall improvement progress has been very patchy, to the extent that "many of the old 'white' areas of the Beaver Report are now dirtier than many of the 'black' ones. For instance, *'white'* towns *without* smoke control which have winter mean concentrations of smoke *greater* than $80\mu g/m^3$" (beyond which, with a roughly similar concentration of SO_2, the condition of pulmonary disease is worsened) "include Barnard Castle, Barrow in Furness, Carlisle, Chester, Grimsby, Kendal, Leek, Macclesfield, Morpeth, Northallerton, Ripon, Scarborough and Whitby, while *'black'* towns *with* smoke control whose mean concentrations are *lower* than this figure include Bristol, Coventry and Leicester as well as almost all of London and substantial proportions of many other large urban areas".

We thought it was difficult for further progress to be made in domestic smoke control by local authorities unless the Government were to issue guidelines for the purpose. "The amount of smokey fuel burnt in an area provides a rough guide to the amount of smoke emitted and is one factor in assessing whether smoke control is likely to be needed. Other factors include population density, topography and climate. The guidelines should also refer to sulphur dioxide concentrations. The energy savings which smoke control can bring about need also to be borne in mind and should be referred to in advice accompanying the guidelines. The savings result not only from the use of more efficient fuels but also from old open fires being replaced by much more efficient modern appliances." We hope that these guidelines would "help local authorities make faster progress with smoke control than they might otherwise do by enabling them to identify and concentrate resources in areas of the greatest need".

Before I leave the topic of smoke control I would like to refer to the magnificent studies by Ashby and Anderson of the historical roots of the Clean Air Act of 1956, published in Interdisciplinary Science Reviews. "The choice before Londoners was either to change from open fires to closed stoves burning anthracite or coke, as the social price to pay for cleaner air; or to continue to enjoy the 'pokeable, companionable' open grate, at the cost of fogs which caused death and illness and paralysed transport. In the 1880s the technology for smoke control was already available; it was social resistance to it which prevented its application. The anti-smoke lobby failed to get more effective laws through Parliament; but it did valuable service in keeping the issues before the public and lifting social norms for the environment towards the 'threshold level' which, two generations later, made stricter smoke abatement laws acceptable".

These events of a century ago marked the beginning of a movement in which society was increasingly to demand that the abatement of environmental pollution was an acceptable limitation to put upon the freedom of industry and of the individual alike. But it was not a battle easily won, as Ashby and Anderson make abundantly clear. Indeed, some of the *official* arguments against the control of the domestic grate resembled curiously the arguments of the *opponents* of nuclear power today. Thus, according to the Prime Minister, Lord Salisbury, in 1892, to administer a smoke-control law which covered domestic fires would require an extension of the inspectoral system "which would frighten the most enthusiastic advocate of modern legislation. Conceive of an inspector going to every house in London and seeing that the grate was properly fitted in order not to emit smoke! The burden of itself would be worse than the London fog". Perhaps the proponents as well as the opponents of nuclear power can draw some comfort from this early raising of the issue of *civic rights* in the struggle between energy and the environment.

Perhaps I could end my address with a few, more

serious, comments on this very difficult problem. One has somehow to find a balance, satisfactory to ourselves and, if possible, not having irreversible consequences for future generations, between the provision of energy without which wealth creation could be difficult if not impossible to achieve, and the maintenance of the environment and public health and safety without which that wealth can hardly lead to an improvement in the quality of life. It is rather like inflation where increasing income is of no avail unless prices rise less rapidly.

Many of the environmental problems which arise from the provision of energy are local ones for which technology will provide a remedy if the cost is reasonable. These include water pollution from mining, transporting fuels, and disposing of waste heat from power stations, and air pollution from vehicles and from the combustion of fossil fuels. One should also include problems arising from the need to dispose of large quantities of radioactive wastes, for which the proposed solutions have yet to be convincingly demonstrated. These, however, are problems which will not receive adequate attention unless environmental departments take part in the formulation of energy policies which, until recently, they did not. They may have helped to deal with the consequences of any given course of action after the event, but that is quite a different matter. Indeed until less than a year ago they appeared to believe that they had no standing in some of the major issues of the day.

But there are also beginning to arise problems for which the balancing act is proving very difficult indeed, because in trying to strike the balance one has to contemplate the behaviour of the earth and of its citizens far into the future and on the global scale. One can escape a purely local problem, if necessary, by going somewhere else and starting afresh: it is the nature of a global problem that escape is impossible.

One such global effect which may result from the burning of fossil fuels is the so-called greenhouse effect. The inevitable end point of fossil fuel combustion is the production of carbon dioxide. The concentration of CO_2 in the atmosphere is increasing at about 1 ppm every year. Some of this increase may come, not from increased combustion, but from clearing the world's forests, since plants absorb CO_2 in the process of growth. Until more work has been done we do not know whether it is increased fuel or decreased forest that is mainly responsible. Perhaps if we were gradually to restore the forests we could forget about it. But if most of the increased concentration comes from fossil fuel, and if fossil energy usage increases as many expect, the CO_2 concentration might then double in less than a century. In turn this might raise the average temperature of the earth by 2°C, and even by 10°C at the poles. It is difficult to foresee all the consequences of such a climatic change; they might include a partial melting of the ice-caps and an increase in the incidence of skin-cancers. I stress, however, that we cannot yet be sure even about the beginning of this train of thought let alone the end: there may be no possibility of a CO_2 catastrophe at all, and even if there is we may yet find ways of ameliorating its consequences.

On the other hand, if we decide to rely upon nuclear energy as an alternative we are faced with other difficulties, some of them in their turn unknown in magnitude. In addition to the problems of nuclear waste disposal, some of which, such as the resulting contamination of the seas, raise global issues, we also have the problem of how to control the proliferation of nuclear weapon capability, to nations and to illicit groups, in a world dependent upon fissile materials for its energy supplies.

Alvin Weinberg, commenting on this dilemma, has said: "To weigh proliferation against climatic change is surely beyond human wisdom." But if it is the problem facing the human race we had better acquire that wisdom. A problem of such consequences cannot be ignored simply because it seems too difficult to solve.

We should obviously be developing the tools to solve such problems. And we should endeavour to establish whether we really are faced with such a cruel dilemma. Are there other choices open to us? Those who are pressing so hard to save the threatened nuclear industry are urging us to say that there are not; or if there are, that they will not be available in time to fill the dreaded energy gap during the course of which it is suggested that more people will die of cold than of proliferation. There's an emotive argument for you!

But need it be so? If uranium did not exist, so that fission power was impossible to achieve, would the world be running out of energy just about now? I do not believe it would. Instead of pinning all our faith on nuclear energy 25 years ago—for the Queen opened Calder Hall in the first year of her reign!—we should have been busy looking at the alternatives, those which at last are beginning to be seriously studied with the support of substantial public funds. I refer, of course, to those sources which ultimately derive their power from the sun and the moon—the wind, the waves and the tides, solar power, and above all upon conservation whereby one reduces one's demand for energy and adapts what remains to the form in which the energy can most appropriately and least wastefully be used.

There is little doubt that these alternatives have occurred to us too late to avoid nuclear power altogether at the present time even if we wish to. We shall be forced into it, globally, because we have left ourselves no choice—unless, that is, the world is rather soon to turn its back upon energy-dependant economic growth, something it shows little sign of doing. That means that we shall be forced into accepting some of the risks, too, before we have seriously begun to face up to them. And for this the nuclear industry itself must share the blame, because it has naturally suited its books not to bring to public attention problems it did not know how to solve.

I will not dwell on the subject matter of the Royal Commission's Sixth Report—Nuclear Power and the Environment—any longer, except to welcome the fact that the Government in its recent White Paper has accepted the bulk of our recommendations. In particular, by agreeing that the problems of nuclear waste disposal should in future be under the supervision of the environmental departments rather than the industrial sponsorship departments; by setting up an enquiry into the proposed Windscale extension, and by promising to provide a full public enquiry before any decision on the next stage of the fast breeder reactor programme is implemented, the Government has demonstrated how it now understands the need publicly to take into account environmental considerations in framing energy policy.

I ended my address at your Edinburgh Conference last year as follows: "I suppose you could say that if there is a single theme to all our work so far (including the first three Reports under the Chairmanship of Lord Ashby) it is that it is time we had a Department *for* the Environment instead of a Department *of* the Environment. I mean that we need to know that there is a Department of State whose sole job it is to put the wise management of all aspects of the environment first. Many of our proposals are intended to have this effect, because we insist that environmental control should be the responsibility of the environmental departments, not the sponsorship or employment

departments . . . It is why in our Fifth Report we recommend the return of the Alkali Inspectorate to the control of the Department of the Environment, and the larger role of HMPI; it is why in our Sixth Report we insist that environmental aspects of the nuclear power programme . . . should be under the control of the environmental departments. And it is clear to us that in spite of the doctrine of indivisible Cabinet responsibility for Government decisions, some way has to be found for bringing out into the open the different, and often conflicting considerations which enter into a final decision . . . "

Since then, the White Paper has conceded the point in the context of our Sixth Report, thus removing a major Vexation. Let us therefore be hopeful that the Government will soon respond in similar vein to the Fifth. If it does, this Society can feel that it has played an important part in bringing that about, both by its own recommendations and by providing a forum for public exposition of some very difficult issues. Whatever the outcome, however, the work of the Society will not diminish, for the cause of clean air, and of environmental quality more generally, requires eternal vigilance.

Dust Control in Industry:

The Dichotomy between Requirements and Resources

Peter Swift, BEng, CEng, FIMechE*

As the understanding of the new Health and Safety at Work Act matures, its eventual impact on industrial practices in both scale and scope is seen to be almost limitless.

Not that any responsible person would disagree with the Act in principle: but equally any responsible person can only be concerned to a very great degree at the effect the Act can and will have on the health, safety, working customs, careers and standard of living of all those concerned. Because, and make no mistake about this, for the Act to succeed, the total and unstinted co-operation of both sides of industry will be essential.

The instinct of most industrial societies is to expect and demand higher standards of living; given the choice between increased safety on the roads and considerably fewer motor cars, the motor car wins; between better health and no smoking, tobacco is not defeated. So should the cost of implementing the new Health and Safety Act begin to result in a rise in prices, and be seen to do so, will the Act have the support or tolerance of the majority of the population, as any interventionalist Act must have to succeed in the long run. Clearly, the effect upon unit costs and productivity must be constrained within bearable bounds.

Just one field of industrial hygiene that will be so affected is that of dust control. Dust control is a facility required by so much of industry, from knocking out large castings to the filling of tea bags. Great progress has been made in the acceptance and application of dust control over the past 25 years. Excluding particulate product control or process dust control such as flyash from pulverised fuel boiler installations, and concentrating specifically upon nuisance dust control within factories, one can divide the problem into two easily recognisable major components—control of dust and collection of dust.

Knowledge, understanding and experience of dust collection has been given much attention of late. The performance characteristics and limitations of cyclones, wet washers, electrostatic precipitators, fabric filters and inert filtration are now more widely known by both user and supplier so that gross errors in application are becoming less frequent. Albeit the wide variation of apparently acceptable filtration velocities that can sometimes be encountered in a number of competitive quotations for a fabric filter application is still a matter of concern.

The problems arising from the control of dust have not perhaps received quite the detailed attention which they warrant. Control of nuisance dust precedes collection, and as far as the Health and Safety at Work Act is concerned, the effectiveness of dust control exercised within the factory is of the greatest importance. This effectiveness is governed by many factors. The two principle ones are the design and location of the hood and the consistent volume of air entrained there through.

For many dust producing operations such as grinding, polishing, sieving, sawing, machining, mixing and the like, there is a general concensus of what is required in hood design and location, and in the air entrainment required. But industrial methods and operations are anything but static and such changes, as well as the coming into use of new materials, often produce situations involving dust generation, the dust control solution of which involves innovation and uncertainty of attained performance to some degree.

It is difficult to be dogmatic about what the best approach would be in a situation of this nature, either for the supplier, or the user of dust control equipment, or for that matter, the various statutory authorities concerned. Everybody involved wants the right solution to be selected, one that will exercise effective dust control for as long as the particular operation is carried out. But the user wants to buy the plant concerned as economically as is possible; dust control is a substantial on cost in such circumstances and no one disputes the financial pressures on productive industry these days. The supplier wants the business, but not at a loss, nor does he wish to become involved in disputes over the achieved effectiveness of performance once the plant is in operation, and the possible compensation or other costs that the new Act may engender.

One is driven to the conclusion that dust control problems of a more esoteric nature may not necessarily best be resolved by the normal process of calling for competitive quotations from a number of dust control manufacturers and then, after playing one against the other, selecting what is considered the best buy, which, more often than not, is judged to be the lowest tender obtained. Such a procedure, particularly when the dust producing process is not yet in operation and available

* Environmental Consultant, Swift Technical Services Limited, 7 Manor Close, Oadby, Leicester LE2 4FE.

for inspection, can lead to the competitors lowering their standards under the commercial pressures generated, resulting too often in a dust control plant which is barely adequate for the task for which it was designed, even after whatever improvements, which were found possible at reasonable cost, have been carried out, after installation when more facts are then available. At the risk of being suspected, or even accused, of special pleading, such problems are better resolved by open discussions with a number of suppliers, before selecting one to tackle the problem in partnership with the user and an experienced impartial consultant.

Of course, on many applications, the Statutory Authorities have tremendous influence over the solution selected. In cases where there is asbestos or lead, for example, the requirements of the Authorities may move the anticipated cost and practicability of the control plant visualised into another dimension.

Probably the Authorities most involved are the Factory Inspectors, the Alkali Inspectors and the Local Authorities. The two former have grown up with Industry, are well accepted and respected and have a record of helpfulness and reasonableness. It is perhaps too early to pass judgement on the contribution the Local Authorities are making to the solution of these difficult problems. What is essential is that those in industry dealing with such matters feel that there is a degree of involvement of the Statutory Authorities in the solution of the problem, and that they are not only concerned with setting standards, some of which can seem arbitrary and inexplicably severe.

Because Industry not only has to do the job, it has to be able to do it competitively in a world wide industrial scene. Industry cannot accept any scheme for Health and Safety: the price may be astronomical to the point where the process is abandoned, labour made redundant even.

There is, in these times of financial austerity and one and a half million unemployed, a greater need than ever for a positive pragmatism by all concerned, management, labour, national and local authorities. Health and Safety can be an emotive subject; those who have sat on some Safety Committees know that it can be very difficult to draw the line and say that a process is safe enough, the right compromise between cost and effectiveness has been achieved, or is thought to have been achieved. Even more difficult for one individual member to do so.

It is essential that the basis of local Government decisions in environmental matters are understood; better still that they are discussed with those directly involved before they are published as regulations, with all the subsequent rigidity that thereby follows. There must be a balance between the Authorities devising, imposing and administrating environmental legislation, and those attempting to produce equally essential goods and services and who are just as concerned about the welfare of their work force. Yet one sometimes sees such pressures and restrictions imposed on a Company trying to expand, modernise its processes, or build up a new factory, that one wonders where they find the strength, patience and persistence to continue. Not only do they have to overcome all the commercial problems and difficulties that face any business trying to be profitable and tax worthy today, on top of all those discouragements, they face the sometimes almost insoluble problem of satisfying a number of different Authorities on environmental aspects, often involving enormous investment and, above all, time.

Yet dust control is not that precise a science. It is not applied like a 30 mph speed limit. Not only are the standards applied often ill-defined, the measurement of the results obtained can be equally difficult and complicated. There are difficulties enough therefore, in obtaining satisfactory dust control in the first instance and continuing to obtain it throughout the life of the plant.

Take the general problem of asbestos. This was regarded as an essential industrial material, in many applications it still is. Yet the very mention of the word asbestos is now sufficient to cause a very positive feeling of unease and insecurity in any work force. One reads of trains being taken out of service when it is discovered that asbestos was used at some stage in their construction. Or parts of hospitals being closed when asbestos insulation in a corridor wall is disclosed during building alterations. Presumably nationalised institutions can afford and justify these reactions. But what would happen if this approach was applied over the whole of industry where asbestos was used, had been used, or was a basic raw material.

The asbestos using industries have made a tremendous effort to ensure effective protection to their workers. This has involved a detailed analysis of all their working, transport and storage procedures. Defined operations creating asbestos dust are provided with the best possible standards of dust control, with the plant operation checked frequently for effectiveness. Plant operational parameters are defined, checked and recorded. The record books are inspected periodically by Authority. Management is committed to doing all it can to make dust control effective in these known hazardous applications.

But all their efforts can be nullified without the co-operation of each individual worker. Take for example, flat asbestos sheets being stacked, one on top of the other. If one sheet is dropped on another, the air in between is forced out at high velocity. This must, presumably, disperse some fibres into the working atmosphere, some perhaps, even in the 2 to 5μ range. It is in the operator's interests to stack the sheets gently, each and every one. A case where an understanding of what is at stake will make the need for controlled working methods and self discipline a matter of supreme self interest to those concerned, whether they are under continuous supervision or not.

Then again, take the question of dust collectors. The asbestos using industry had made great investment in the use of modern fabric filters, designed for continuous operation, with most of the maintenance effected from outside the filter on the clean side. Yet the collected dust still has to be moved, rotary valves serviced and hoppers occasionally cleared. This work must be done under the most carefully delineated conditions, with full protective clothing, no matter how warm the weather. There is just no other way in which this work can be contemplated.

The Health and Safety Act is also causing re-examination of older filter plants. Those handling such dusts as asbestos are now being examined, as a matter of urgency to see how they can be modified to take the bulk of the inspection and maintenance out from the dirty side of the filter to either the clean side or outside the filter altogether. It is clear that where such modi-

fications are not possible, the working life of such plants has now a very limited duration.

It is also probable that a periodic testing of all dust control plants will now be required at regular intervals, logged, witnessed, checked, registered and agreed. But what form will the tests take? Most plants are not designed with periodic testing in mind, with lengths of straight ducts conveniently sited for accurate pitot searches. Or should the testing be first confined to dust counts or other measurements at agreed points in the working area. And if the results show an unacceptable decline in working conditions measured against an agreed standard, then the performance of the dust control plant, from the condition and location of the hoods, through the air entrainment rate, down to the collector performance, must be measured, analysed and the necessary corrective actions taken, assuming of course, that the process over which dust control is being exercised has not changed since the installation of the plant. And where are these numerous trained environmental engineers coming from; who are going to carry out the very large number of plant tests at regular intervals, tests which require no little skill and experience to do properly, because of the enormous number of variables applying to each plant, not to mention the unenviable task of interpreting thereafter the results, to the satisfaction of all concerned.

The sheer volume of effort that will be needed to operate dust control plants to the standard of effectiveness demanded by the Health and Safety Act leaves no alternative to a totally constructive combined effort from all concerned. Above all this includes the Statutory Authorities.

They must avoid, at all costs, becoming an aloof faceless image, dictating with Olympian detachment the environmental standards they consider appropriate. They must work with sympathy, understanding, with commitment and involvement, to bridge the gap between those who administrate and those who are administrated, between those who govern and those who are governed. Because the pressures on those who manage and produce are dangerously high, their incentives, in many cases, uniquely low. And the equation is very simple: no production = no viable society. So when a process leads to an entrained effluent of many thousands of M^3/hour with barely milligrammes of lead dust/M^3, the very stipulation of reverse jet filters leading to an exit stack 40 metres high ensures total safety at an incredible price. All right for the Authority; a major problem in economics and perhaps even in accommodation for the manufacturer. But is that standard of solution absolutely necessary? Would something else, imposing not quite that level of capital and running costs, be justified. For, even in good times, we cannot afford to let the perfect be the enemy of the good.

Unless we all play our part, we shall not succeed. Already some dust control manufacturers are withdrawing to safer areas of operation by concentrating on the economical production of standard dust collectors in large numbers. This some do extremely well, and make a very good profit. But at the same time they are reluctant to become involved with the detailed application of their collectors and the custom designed and built items which are the essential other half of a dust control plant, such as hoods and ducting. These activities they tend to eschew, because they are labour intensive, involve site work, and are prone to costly errors. So they tend to leave this problem to the smaller man, the local sheet metal worker: let him discuss the many details with the client, measure, manufacture and install the rest of the plant. If the larger manufacturers elect to take this path, so be it. In time the free market forces will give the smaller man the respect and return for his labour which he deserves. But until then, could not the larger dust control companies, making such splendid profits on their standard off the shelf collectors, help by giving the smaller man a discount larger than the 10 per cent they normally offer in such circumstances? Something nearer 30 per cent would allow the small sheet metal worker to spend time getting his hoods just right, identifying the most economical duct runs, making sure the plant was commissioned correctly, that the user fully understood the principle of his plant's operation, the required maintenance regime, the symptoms to look for to identify fall-off in performance, or plant mal-function, before the plant deteriorates far enough to endanger the worker's health unknowingly. Because that is what dust control is all about—the continuous protection of life and health and well being.

It needs the unreserved co-operation of the work force: it calls for total frankness, commitment, and effort on the part of management, it deserves the co-operation, encouragement and help of the Statutory Authorities. Without all of these, some of the precious national resources invested in this worthy field, however well intended, will be wasted. And when we know that, for some years to come, the resources available will not be able fully to satisfy the requirements, that is one mistake we must avoid and it is within our means to do so.

POLLUTION ABSTRACTS

63 Coal Burns Cleaner in a Fluid Bed. P. F. Fennelly, H. Klenim, R. R. Hall and D. F. Durocher. Environmental Science & Technology, Vol. 11, No. 3, March 1977. Pp 244-248.

Fluidised-bed combustion systems operate at a significantly lower temperature than conventional systems (about 1650°F vs 2700°F, respectively). To answer questions raised concerning the emissions that could result at those lower operating temperatures, a preliminary environmental assessment is made here. It is widely known that fluidised bed combustion of coal results in low SO_2 and NO_x emissions, therefore the article pays attention to trace elements, organic compounds, and particulates. Pollutants and their occurrence are described, concentrations estimated and control technology outlined.

Reader Enquiry Service No. **7734**

64 The Effectiveness of a Tall Stack for Reduction of Ambient Sulphur Dioxide Concentrations: A Field Investigation. James J. Mutch. J. of the APCA. Vol. 27, No. 6, June 1977. Pp 567-571.

Of many available methods for limiting ground level pollutant concentrations, tall stacks are many times the simplest, most effective and least costly. Although this is theoretically explicit, field validation of the soundness of this approach is often hampered by lack of comparable "before" and "after" data. In this study at the Alma Power Plant, Wisconsin, USA, appropriate air quality and meteorological measurements were made for several years before and after conversion from short to tall stacks. Comparison of these data shows that the tall stack has reduced ambient levels of SO_2 by from 50 to 95% in the vicinity of the plant. This study also found that use of a Turner-Briggs dispersion model in a valley site gave fairly accurate and reliable estimates of air quality. The model was useful in designing the tall stack, assessing its impact and locating air quality monitors.

Reader Enquiry Service No. **7735**

65 Electrostatic Precipitation of Fly Ash. Harry J. White. J. of the APCA, Vol. 27, Nos. 1, 2, 3 and 4. Pp 15-21 (January 1977); 114-120 (February 1977); 206-217 (March 1977); 308-318 (April 1977).

The purpose of this four-part paper is to present a broad fundamental and practical discussion of the important phases of fly ash precipitator application and technology. Subjects covered are: Outlook for future growth; Fundamental operating principles; Fly ash and furnace gas characteristics; Precipitator design; Hot precipitators; Precipitator equipment; Precipitator problems; Case histories of precipitator installations. These are examined in the context of the pace-setting requirements of the US Federal Clean Air Act of 1970, which established new and much more severe standards both for performance and reliability of air pollution control equipment for power plants and other heavy industry. Fundamental advances in the science and technology as well as the procurement methods for precipitators for the high efficiency control of fly ash emissions have emerged under the force of the legislation. The paper aims to clarify these advances and provide guidance for air pollution control engineers generally, as well as to specify applications and performance problems under complex conditions.

Reader Enquiry Service No. **7736**

66 Chemical Reduction of SO_3, Particulates and NO_x Emissions. I. Kukin and R. P. Bennett. J. Inst. of Fuel, March 1977. Pp 41-46.

The chemical treatment of fuels and flue gas to reduce polluting emissions was subjected to quantitative field tests to verify its practicability as a possible economic solution to current energy and pollution problems for electric utilities. Manganese added to a residual fuel oil at 50 ppm reduced sulphur trioxide emissions by up to 55%. Manganese has also been effective in reducing nitrogen oxide emissions by as much as 31%. Chemical conditioning agents for the ash in the flue gas of coal-fired units have been used to improve electrostatic precipitator collection efficiency by 50-90%, so that the units complied with emission regulations. The units have been able to operate at increased capacity while still complying with regulations. Chemical neutralisation of SO_3 in the flue gas, resulting in a lowered acid dewpoint, allows operation at reduced exit gas temperatures without corrosion of the airheaters, stacks or ductwork. This results in improved efficiency and reduced fuel consumption, while inhibiting acidic emissions. Examples from case histories illustrate how environmental protection can be obtained, at least with regard to SO_3, particulates and NO_x, without incurring capital expenses.

Reader Enquiry Service No. **7737**

67 Monitoring "Rijnmund Smog" for Alert Conditions. J. E. Evendijk and P. A. R. Post van der Burg. J. of Environmental Science & Technology, Vol. 11, No. 5, May 1977. Pp 450-455.

Owing to the presence of many factories, the population of Rijnmund is deeply concerned about air pollution problems. Most frequent and worrying to the public is stench, or noxious odour. Smog, less frequent but more complex, is of great concern to the authorities who are unable to control the smog whilst lacking information regarding its constituents. Dust emissions can also cause local nuisances, often due to transshipment activity. To reduce the effects of air pollution episodes, a network of monitoring stations has been built up by the Central Environmental Protection and Management Agency Rijnmund. Public authorities and industry co-operate closely, and alerts are issued to enable industry to reduce emissions voluntarily when critical pollution levels are in prospect.

Reader Enquiry Service No. **7738**

68 Air Pollution Control Philosophies. Noel de Vevers. J. of APCA, Vol. 27, No. 3. Pp 197-205.

Most air pollution control programmes rest on one or more of the following four basic philosophies: emission standards, air quality standards, emission taxes, and cost benefit analysis. Frequently they rest on mixtures or combinations of these four. This paper examines each of the four separately, tries to show why each is different from the others, and compares their advantages and disadvantages.

Reader Enquiry Service No. **7739**

BOOK REVIEWS

The Fate of Pollutants in the Air and Water Environments
Part 1. Editor I. H. Suffet. Volume 8 in the Wiley Series in Advances in Environmental Science and Technology. New York—London. 1977, 484 pages, £18·70

This book is based on papers presented at a symposium held in Philadelphia in April 1975 by the American Chemical Society. The aim of the symposium was to improve the scientific understanding of the behaviour of pollutants in the environment, and thus to provide the background of scientific knowledge which is essential if sound policies for pollution control are to be devised and implemented. With the present public interest in maintaining the quality of the environment, among the American public in particular, it is clearly desirable to know how the atmosphere, the oceans, the rivers, plants and animals will be affected by any new or increased source of pollution. One also needs to know the ultimate fate of each pollutant. Does it finally undergo chemical change into some more acceptable form, or may it be accumulating in some corner of the environment, still retaining its toxic or noxious properties? One may suspect that the planners of the Philadelphia symposium were aiming at ways of calculating the movement of any pollutant through all parts of the environment from its source to its ultimate fate. In the current jargon, they aimed to develop (mathematical) models of the movement of pollutants through the environment. Certainly in the articles in this book there is plenty of emphasis on modelling, but as one reads them it becomes clear that satisfactory and comprehensive modelling is still a long way off.

Nevertheless this volume does represent an important and effective step towards the scientific and model-based management of pollution. In their 18 separate contributions to the volume the individual authors cover many different aspects of the behaviour of pollution in many different parts of the environment. They consider physical, chemical and biological aspects as well as transport by winds and water; also behaviour in the atmosphere, ocean, estuaries, rivers and on the land surface. Moreover, each presentation, although of limited scope, has been devised in relation to the flow of pollution through the environment as a whole, and with the requirements of numerical modelling in mind.

The volume reviewed here is divided into two sections. Papers in the first, under the title ‘Mechanisms of interaction between environments’, aim to provide a basic picture of the way in which pollution moves through the environment. The second, entitled ‘Methods of mathematical modelling, the fate of pollutants, and the physical fate of pollutants’, deals primarily with the technical problems of devising mathematical models. Volume 2 of the book will contain articles on the behaviour of individual pollutants in air and water, and thus, hopefully, will lay some of the foundations for representing specific processes in mathematical models.

It would not be practical to review the contributions individually, but the reader is left with the impression that there are many hurdles to be overcome on the road to comprehensive and quantitative pollution models. First it is clear that there are many serious gaps in the scientific understanding of the physical, chemical and biological processes involved, and, second, there are differences of approach between chemists, physicists, biologists and mathematicians which will have to be bridged by a new breed of pollution modellers.

For the would-be pollution modeller the book is an excellent starting point. Many aspects which he needs to consider are touched upon, and the documentation of the individual contributions is very full, thus providing a valuable introduction to the wide and scattered literature. The book also contains reports of three panel discussions at the Philadelphia meetings, but they do little more than emphasise the compartmentalised interests of the individual contributors, and remind the reader how difficult it will be to weld their contributions into a single science of pollution behaviour.

Curiously, although atmospheric chemistry has been a rather neglected subject, in this volume the atmosphere appears as the region for which most systematic treatment is currently possible. The initial article by Professor C. E. Junge gives an excellent review of the basic considerations related to the fate of pollutants in the atmosphere, but in the other media, oceans, rivers and soils, pollution movement does not yet appear to have been treated in such a thorough and fundamental manner.

In regard to the modelling problem two of the contributors, F. M. Morel, and J. G. Yeasted, comment upon the many reasons which prompt the development of large models encompassing all chemical, physical, and biological processes relevant to the fate of pollutants and upon the ‘sheer fun’ of the exercise of model making. However they express a very pertinent warning of what they call the ‘Black Box’ effect on potential users. The more complex a model, the more compelling its results. A typical user is not likely to examine critically the hidden, and obvious, assumptions of a complex model regardless of the warnings of its author. It is therefore salutory that many contributors emphasise the need for research into the processes that must be modelled, rather than into the building of the models themselves. However, it is in the attempts to build numerical models that the deficiencies in our understanding of such processes come to light, and it is by the discipline imposed by model building and subsequent verification against observations that the science of pollution management will be advanced. This book is a first step in this direction.

J. S. Sawyer

Public Health Risks of Exposure to Asbestos
Professor R.L. Zielhuis. Pergamon Press. pp. **149**. **$12.**

In 1975 the Social Affairs Directorate of the European Economic Community called for "a preparatory study basic to the setting of guidelines for asbestos exposure, as present in various components of the environment, in regard to protection of public health".

The task of producing the study was entrusted to Prof. R.L. Zielhuis of the University of Amsterdam who, together with a group of six colleagues of notable medical and engineering experience, submitted their collaborative report to the S.A.D. in June 1976. The "Zielhuis Report" was released for publication in April 1977.

The "Zielhuis Report" must be welcomed as a most timely and important document which makes a valuable contribution to assessing current knowledge on the health risks associated with asbestos. While the authors have not in any way attempted to introduce new or original research attributable to themselves (other than reference to previously published works) they have succeeded in producing a rational analysis of "the enormous output of data" which has been published over the past ten years and which appeared relevant for guidelines serving to protect public health.

Within some fifteen chapters the Report covers the physical properties and uses of asbestos; the detection and sampling of asbestos fibres, pathological mechanisms and biological indicators; areas of occupational and public health risk; dose-response relationships; orientation of environmental exposure risks; suggestions for further study and concluding recommendations.

As with any Report of this nature it would be misleading to pick out and comment upon any particular opinion, statement or recommendation. The Report must be read and considered as a whole and in the manner for which it was originally commissioned. When done so, it is seen to be sufficiently penetrating to cut through the morass of both relevant and irrelevant data which has given rise to so much misunderstanding and sensational reporting.

It must be noted that for informed readers in the U.K. the Report inevitably reflects upon circumstances and conditions in continental Europe where, in many instances, occupational and environmental controls are perhaps less severe than in Britain. This is particularly evident in the concluding recommendations where many parallels are drawn with existing U.K. practice and legislation.

The "Zielhuis Report" presents in clear, concise terms, the most pertinent facts concerning the relationships between asbestos exposure and asbestos related diseases, while at the same time leaving the reader with a proper sense of perspective as to the general scale of risk. The vast bulk of available medical evidence, upon which the report is based, is of course almost entirely related to circumstances and conditions which, by todays' standards, would be considered intolerable. This is clearly reflected in the Report which does not present much that can be considered new in terms of current knowledge. Its concluding recommendations are therefore directed toward the need for Community and National action in establishing and maintaining the safest practicable environmental and working conditions for the future, but without stating any specific criteria.

Among the Report's conclusions as to the probable scale of public risk the following statement is significant, " ... it can be concluded that it is impossible to come to a reliable quantitative assessment of the risk of malignancies for the general public; present evidence does not point to there being a threshold level of dust exposure below which tumours will never occur. There is very likely a practical level of exposure below which it will be impossible to detect any excess mortality or morbidity due to asbestos . . . Thus, there is likely to be a level of exposure (perhaps already achieved in the general public) where the risk is negligibly small."

The "Zielhuis Report" should become required reading for everyone who is concerned for, or associated with the realities of asbestos and health.

J.K.G.

Smoke, Dust and Haze (Fundamentals of Aerosol Behaviour)

S. K. Friedlander. John Wiley & Sons Ltd. 317 pages. £11·35

This work by Dr Friedlander is stated to be the first classroom text on the fundamentals of aerosol behaviour. As explained in the introduction the term 'aerosol' is used to describe all systems of small particles suspended in air or another gas and therefore covers the phenomena of dust, smoke, fume, haze and mist.

The book presents a rigorous mathematical approach to aerosol behaviour and is intended as a text book for University courses in Environmental and Chemical Engineering. As such it is probably of limited interest only to the general reader. Even so the mathematical analyses are straightforward and should be readily understood by readers with a rudimentary knowledge of differential and integral calculus extending to partial differentials.

Perhaps the greatest contribution made by Dr Friedlander's book is bringing together the various disciplines which are of concern in studying aerosols. Thus chapters are concerned with: aerosol characterization; transport properties; deposition by convective diffusion; inertial deposition; light scattering and visibility; experimental methods; collision and coagulation; thermodynamic properties; gas—to particle Conversion; the general dynamic equation for the continuous distribution function; and Air quality-emission source relationships.

Perhaps the most interesting chapters to the general reader are those concerned with light scattering and visibility, experimental methods, and air quality-emission source relationships. As Friedlander points out, visibility degradation is one of the most obvious manifestations of air pollution and, conversely, that light scattering methods are widely used to measure the sizes of individual particles or the integrated optical behaviour of an aerosol cloud. While it is possible to control the variables in laboratory studies and to obtain reasonably good agreement between theory and experiment, in actual practice the situation is much more complex and the author suggests that this branch of air pollution research is not well developed.

Inevitably most of the mathematical analyses refer to ideal conditions which seldom if ever obtain in practice. Thus, the section in Chapter 11 dealing with predictive models for discharge from a stack—surely a matter of great interest to clean air specialists—provides a rigorous equation for the determination of vertical diffusion flux but, presumably, in *still air*. One would like to see this aspect of the theory developed taking into account air turbulence and, particularly, winds. On the other hand the mathematical approach is of direct relevance in the design of filtration systems, electrostatic precipitators and other devices—and for that matter heat exchangers, where unwanted deposition can occur, as Friedlander points out.

It may be deduced, therefore, from Friedlander's book that whereas experimental methods and measurements are fairly well developed for systems in which the variables can be controlled, very much more needs to be done to understand what really happens in the atmosphere. A primary need is for better instrumentation; as Friedlander points out "identification of chemical compounds in individual particles is usually beyond our capabilities" although some success has been achieved with the electron microprobe.

For field analysis, "an ideal measurement instrument would automatically and continuously size and chemically analyse each particle individually, thereby permitting the determination of the size—composition probability density function"; he adds "such an instrument does not now exist". Indeed the chapter on experimental methods is one of the best in the book, well illustrated with good diagrams.

For the practitioner who has entered this complex field through some other route, and who has become skilled in the art by experience (as most practitioners have) study of some of the theory could be illuminating. For example, how many practitioners in the filtration of aerosols understand how particles are trapped in fibre filters in which the spacing between the individual fibres is much greater than the diameters of the particles filtered? Friedlander points out that, in the absence of electrical effects, small particles are collected by diffusion to the fibres and larger particles are removed by inertial deposition.

Essentially, being a text book, Friedlander's work is for reference rather than for reading. Nevertheless the practising technologist in the field will find in it much of interest and value.

D. H. Sharp

The Economic Consequences of Air Pollution

V.K. Smith Ballinger Pub. Co., Cambridge Mass. pp.113 £11.00.

This is a very theoretical book by a very theoretical economist. There are no revelations about the subject of the title, and the theory is not applied to any significant effect to a case of any importance, and nothing directly useful emerges.

The author seems to treat economics as a creed which must be useful, or at least important when applied to any events

which, because they have physical consequences, can therefore be said to have economic consequences. Best experience and practice invites us to get on with the job of air pollution control on much the same basis as we concern ourselves with personal and domestic hygiene, in which fields our decisions are not made on the basis of economic considerations to any extent significant by comparison with other reasons involved. Actually we use best practicable means to achieve an acceptable standard, don't we? But this author doesn't consider bpm important enough to put in his index. Indeed it is difficult for those concerned with air pollution management to recognise their field of activity in this treatise and one wonders whether the author has ever been out of doors or into the likes of a boiler house with his thinking cap on!

R.S. Scorer

Quality of the Environment and the Iron and Steel Industry
Proceedings of a Conference organised by the Commission of the European Communities Directorate-General for Social Affairs, Luxembourg, 24-26 September 1974. Published by Pergamon Press for the Commission. 847 pages, $60·00

This book comprises the proceedings of a conference which embraced the whole spectrum of environmental control in the iron and steel industry, with particular emphasis on recent developments which have resulted from research work aided by the European Coal and Steel Community. The topics covered include control of air and water pollution, water management, noise control, waste disposal and monitoring of pollution.

Although the book inevitably suffers from a certain lack of continuity because of its origins as proceedings of a conference, it is interesting to see the European iron and steel industry freely exchanging information, views and experience on a subject which is clearly of major concern to the industry. Perhaps one of the main impressions from the publication to those not familiar with the industry will be the sheer size and complexity of the pollution control problems that have to be overcome. An integrated iron and steelworks comprises perhaps six or seven separate types of major industrial process and many more minor ones, all on the same site. The pollution potential of these processes differs in type, magnitude and complexity, and this accounts for the large number (35) of technical papers included in these proceedings.

The subject matter included in the papers can be summarised as follows. Policy and legislative controls in the EEC are discussed together with specific accounts of the national controls in France, Germany and the UK. There are detailed papers on air pollution from iron ore stocking, ore sintering and pelletising, coke ovens, blast furnace casting bays, the steelmaking processes (BOS, open hearth, electric arc), and the desulphurisation of coke oven gas. On the water side, water management, effluent treatment at coke ovens, blast furnaces and rolling mills are discussed together with the more general accounts of the overall approach to liquid effluent control at integrated works. References are made to the problems of waste disposal and some useful papers are given on general and specific noise problems. Monitoring of pollution is also covered with descriptions of specific equipment and systems and more general environmental monitoring in the vicinity of steelworks.

It is clear from many of the contributions that great importance is now attached to the overall planning of iron and steel works developments with environmental considerations in mind. Figures of 7% to 18% of total capital expenditure on new plant are quoted as attributable to polltion control, and the significance of these expenditures to the industry is reflected in the proceedings by occasional pleas by contributors that a progressive approach be adopted to environmental control with due account taken of economic factors.

It is impracticable to give a detailed review of this publication within the confines of limited space, but it does contain a wealth of data on the many different facets of environmental control in the iron and steel industry. It certainly provides a useful reference book for specialists within or allied to the industry and will also be of value to those wishing to get an in-depth understanding of the present state of the art for environmental control in iron and steel. For those looking for a more general introduction to the subject without overmuch technical detail, this is probably not the book. The presentation of the text in typescript is disappointing in view of the price of the publication which is, even in these inflationary times, rather high.

C. M. Davis

Ecotechnics. 2nd Edition
Eco Press. 1977. 480 pages. £30 (available from Peter Peregrinus Ltd)

This second, enlarged edition of an international ecology directory lists firms under product headings in five main divisions: Water, Air, Solid Wastes, Noise/Vibrations, Other Technics and Fields of Environmental Control. Subheadings in each section cover main areas of requirement: under Air, three are listed—Equipment and Plant for air intake and exhaust; Air treatment and purification; Devices and implements for air analysis. Within these broad groupings, products are broken down twice to specific function and the manufacturers are listed accordingly. For instance, centrifugal dust removers (cyclones) are listed (in French and German as well) under 13.2.8 : 13—Air Treatment and Purification, 2. Air Purification, 8. Centrifugal Dust Removers. Simple—but it is necessary to know what the functions of products are, not merely their names.

The companies entered are listed alphabetically, under successive country groupings for which there is a simple letter code, which enables you to pounce on the area you want in a glance. The page is in columns, with the company name listed in the first column, road address in 2nd, country code letter in 3rd, town and postal code in 4th, telephone number in 5th and telex in 6th. The type is computer print-out face, which looks blurry and confusing at first but is in fact of great clarity for page scanning. No other details of the products are given (size, function flexibilities, range of applications etc) but since the product description headings are fairly exhaustive, this is not necessarily a disadvantage.

Large firms and specialised libraries that can afford this directory should find it a useful resource when initially tracing names of companies for particular ranges of products. Having established a list of possible names, these can then be checked against directories devoting greater descriptive space to a smaller field.

OECD and the Environment
Paris 1976. 84 pages. £2·60 (available from HMSO)

The Environment Committee of OECD was established in 1970, initially for five years, with its mandate extended for another five years in 1975. Its work mainly consists of a number of well-defined short-term projects generally leading to a substantive report containing conclusions for consideration by governments in designing and implementing their environmental policies. These conclusions often lead to formal acts of OECD's Council—Decisions (binding on all Members, implemented by appropriate national procedure) or more frequently, Recommendations (agreed acts, submitted for consideration within policy of individual Member states). On air pollution matters, a specialised subsidiary body composed of government officials assists the OECD Committee. Some of the achievements of the Committee so far have been the promotion of the Polluter Pays Principle, restrictions on the manufacture and use of Polychlorinated Biphenyls (PCB's) and the Declaration on Environmental Policy (printed in full in the text).

The bulk of this book consists of the Acts of OECD's Council, relating to the environment, printed as drawn up. Current projects are also listed, with a brief description of each. A useful Bibliography of relevant OECD documents is included at the end of the book.

New additions to the NSCA Library

BOOKS

Air Monitoring Programme Design for Urban & Industrial Areas. Published under the joint sponsorship of UNEP, WHO and WMO. Geneva, WHO, 1977. 46 pages. US$2·40.

Air Monitoring Survey Design. Kenneth E. Noll and Terry L. Miller. Ann Arbor Science, 1977. 296 pages. £15·00.

Air Quality in Selected Urban Areas, 1973-1974. Published under joint sponsorship of UNEP and WHO. Geneva, WHO, 1976. 65 pages. US$6·00.

Danish Pollution Control Equipment and Know-How. Federation of Danish Industries, 1977. 103 pages.

Directory of Pollution Control Equipment Companies in Western Europe. Ed. R. Whiteside. Graham & Trotman Ltd, 1977. 614 pages. £19. Reference only.

Ecotechnics. An International Ecology Directory (2nd Ed). Eco Press, 1977. 480 pages. £30. Reference only.

The First 50 Years. Roy Hayman. The Institute of Fuel, 1977. 112 pages. £5·00.

Manual on Urban Air Quality Management. Eds. M. J. Suess and S. R. Craxford. WHO Regional Pubs. European Series No. 1. WHO, 1976. 200 pages. US$14·40.

OECD and the Environment. 84 pages. OECD, 1977.

Proceedings of the 4th International Clean Air Congress. Tokyo, May 1977. The Japanese Union of Air Pollution Prevention Associations, 1977. 1088 pages.

Public Health Risks of Exposure to Asbestos. Ed. Prof. R. L. Zielhuis. Pub. Pergamon Press for the Commission of the European Communities (CEC), 1977. 149 pages. US$12.

Quality of the Environment and the Iron and Steel Industry. Proc. Conf. CEC Dir-Gen. for Social Affairs, Lux., September 1974. Pub. Pergamon Press for the CEC, 1977. 847 pages. US$60·00.

Smoke, Dust and Haze. Fundamentals of Aerosol Behaviour. S. K. Friedlander. John Wiley & Sons, 1977. 317 pages. £11·35.

Strategy of Pollution Control. P. Mac Berthouex and Dale F. Rudd. John Wiley & Sons, 1977. 579 pages. £14·20.

REPORTS AND SELECTED PAPERS

Air Pollution, also **Air Pollution Control with Special Reference to Domestic Smoke Control Areas.** Middlesbrough Council, 1977.

Analysis of Air Pollution Readings for Cleveland, 1966-75. A report for the Committee for the Co-ordination of Air Pollution and Noise. Cleveland County Research and Intelligence, September 1976.

British Gas Annual Report and Accounts, 1976/77. 74 pages. £1·50.

The Central Electricity Generating Board Annual Report and Accounts, 1976/77. 60 pages. £2·00. Also, **Statistical Yearbook, 1976/77.** 20 pages.

A Clean America. Will People Pay the Price? US News and World Report, 7/2/77.

Coal and Coal Prices. Mr Glyn England. CEGB, July 1977. 8 pages.

Concawe and the Environment. What is Concawe? C. Rpt. No. 8/76, January 1977, 12 pages.

Confederation for the Registration of Gas Installers (CORGI). 7th Annual Report, 1976/77. 24 pages.

Costs of Reducing SO_2 Emissions and Improving Effluent Water Quality from Refineries. Concawe Rpt. No. 5/77, March 1977. 47 pages.

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Deep Throat Scrubber. Vic Lusty. Env. Protection Survey, 1977.

Denmark Review—Environment. Special issue, 1977. 32 pages.

The 1975/76 Drought. National Water Council, April 1977. 48 pages. £1·20.

The Electrical Association for Women. 52nd Annual Report, 1976. 44 pages.

The Electricity Council Annual Report, 1976/77. 24 pages.

Electricity—The Permanent Power. Sir Arthur Hawkins. CEGB, March 1977. 16 pages.

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Energy and the Environment. Lord Nathan. The Macmillan Education Lecture. Given at the Annual Conf. of the Geog. Assn., 5/4/77. 22 pages.

The European Community's Environment Policy. June 1977. 34 pages.

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Survey on Quality of Refinery Effluents in Europe. Concawe Report No. 4/77, March 1977. 13 pages.

Test Method for the Measurement of Noise Emitted by Furnaces for use in Petroleum and Petrochemical Industries. Concawe Report No. 3/77, January 1977.

Warren Spring Laboratory. Annual Report 1976. 48 pages.

Books in the NSCA Library

Although New Additions to the NSCA Library are published in each issue of 'Clean Air', many members are not aware of the full range of volumes in the Society's Library. A list has been compiled of all *volumes* (books and reports, *not* papers) held in the library, as at December 1976. Titles are arranged alphabetically under subject headings (e.g. Measurement and Detection, Health Effects of Air Pollution etc.). Members requesting titles on a particular subject can now receive a photocopied sheet, listing the library's resources in that field. Where specific titles are not held, the NSCA Library, as a user member of the British Library Lending Division, can request titles on inter-library loan. In this case, references should included title, author, publication date, and source (if possible).

Emission of Unburnt Solids

Packaged Oil-Fired Boilers can meet British and Foreign Standards

B. Lees, MSc, C Eng, ARIC SF Inst F*
and R. W. Butcher †

The Clean Air Act 1956 was chiefly concerned with the reduction in emission of the solid products of combustion—smoke, dust and grit. Smoke emission has been drastically reduced from domestic, commercial and industrial appliances used in many large conurbations and the improvement in the quality of the air has been dramatic. It has been estimated, for example, that in London during the winter period visibility has increased three-fold since 1958 and sunshine in central London shows an average increase of 70 per cent.

Considering oil-fired packaged boilers of the type widely used in offices, hospitals, schools and commercial and industrial premises, smoke emission has been reduced to a minimal level. This has been achieved by modifications to the design of burners and control equipment. On the other hand, the emission of dust and grit from oil-fired boilers has not been monitored so thoroughly and therefore there is no quantifiable evidence of a marked reduction. Unlike smoke, this type of emission is not clearly visible from conventional oil-fired boilers and other plant and has little effect on visibility and sunshine. The measurement and observation of this form of pollution is more difficult than that of smoke but emphasis is now being placed both in Britain and abroad on reducing these emissions. Standards are likely to be more rigidly enforced in the future. The equipment described in this paper has been developed with the objective of reducing the emission of unburnt solids from oil-fired boilers to well below existing and anticipated standards.

Existing British, European and American Standards

In Britain (1), the basic principle for controlling the emission of dust (particles 1-75 microns diameter) and grit (particles greater than 75 microns diameter) is to use the so-called best practicable means and limits have been fixed for the emission of unburnt solids from plant which is of comparatively orthodox design. In a boiler house with a total capacity below $18{\cdot}2\times10^3$ kg steam/hour (40×10^3 lb/hour) the maximum emission must be less than 4 g/kg fuel oil consumed. Above $18{\cdot}2\times10^3$ kg steam/hour the permitted level of emission varies inversely to the capacity of the boiler house. Unfortunately this can lead to paradoxical limitations. Thus, for a boiler house with a total capacity of $45{\cdot}5 \times 10^3$ kg steam/hour (100×10^3 lb/hour) the emission should not be greater than 2·6 g/kg fuel oil if the boilers are discharging through a single flue chimney even though each boiler has a capacity below $18{\cdot}2 \times 10^3$ kg steam/hour (40×10^3 lb/hour). Conversely, if they are discharging through multi-flue chimneys or through separate chimneys each individual flue or chimney is considered and the emission level may be up to 4 g/kg fuel oil.

In major European countries and in America more stringent standards have been adopted. In France (2) the maximum allowable emission is 1·5 g/kg for plant with an input greater than 8000 thermies/hour.

In Germany (3) the maximum allowable output is 1·5 g/kg fuel oil for small plant with a decreasing allowable emission to 0·55 g/kg for very large plant.

In the USA, the maximum output from plant with a heat input greater than 63×10^3 thermies (250 million Btu/hour) is 1·2 g/kg fuel oil.

It is apparent that the standards vary widely from country to country but if small boilers are to be internationally acceptable the maximum output should be not greater than 1·5 g/kg fuel oil. Secondly, the environmental conditions in which packaged boilers and other small boilers operate do not vary widely between industrial countries. It would appear to be logical therefore that similar levels of emission should be adopted internationally. There is no apparent reason why we in Britain should accept standards which will make British towns and cities dirtier than corresponding conurbations in other countries.

The Level of Emission Achieved by Oil-Fired Boilers

It is difficult to find reliable data on the emission from a representative sample of oil-fired boilers operating under routine conditions. Data has been obtained in Denmark from tests on many small oil-fired boilers used for heating small factories, offices and central heat distribution schemes. The results of these measurements are shown in Figure 1 and random observations on packaged boilers in the UK lead to the conclusion that results are similar. The emission levels under test conditions from the Danish boilers were worse in 20 per cent of the trials than the British standards for boilers with a low output, ie they gave an emission greater than 4 g/kg fuel oil. 50 per cent were worse than 2 g/kg fuel oil and 70 per cent were worse than 1·5 g/kg fuel oil.

It is important to ensure that the solids in the flue gases are measured by standard procedures. Two techniques which use the principle of collecting the unburnt solids on a silica wool filter have been described in British journals (4 and 5). The first system, the BCURA technique, is now a standard design which has been widely adopted. The equipment which has been used for some 15 years has been proved to have a high standard of accuracy and reliability. It is manufactured by Airflow Developments Limited and is fully described in a recent publication (6). The second system which has been developed by the BP Research Centre, Sunbury, specifically for determining the concentration of unburnt solids in the flue gases from oil-fired plant has been proved to be successful over the last 18 years. It is widely used in Britain and on the Continent and may be obtained from Land Pyrometers Limited.

Design of a Cyclone Arrestor for Oil-Fired Plant

Two forms of solids emission may be produced by oil-fired plant, they are smoke and dust.

Smoke consists of particles formed in the course of gas-phase combustion of volatile hydrocarbons resulting from the pyrolysis of the fuel. The production of smoke has been largely eliminated by modifications to burner

* Consultant † British Petroleum Co Ltd

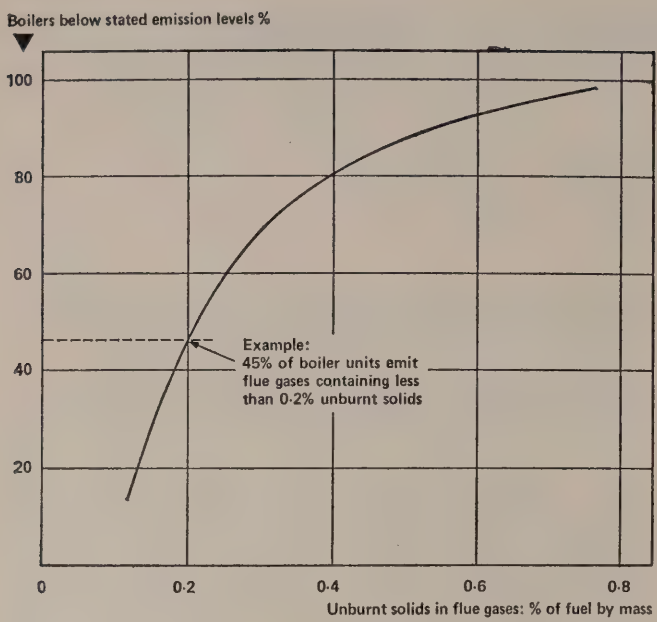

Fig. 1 Emission of Unburnt Solids from Oil-fired Boilers

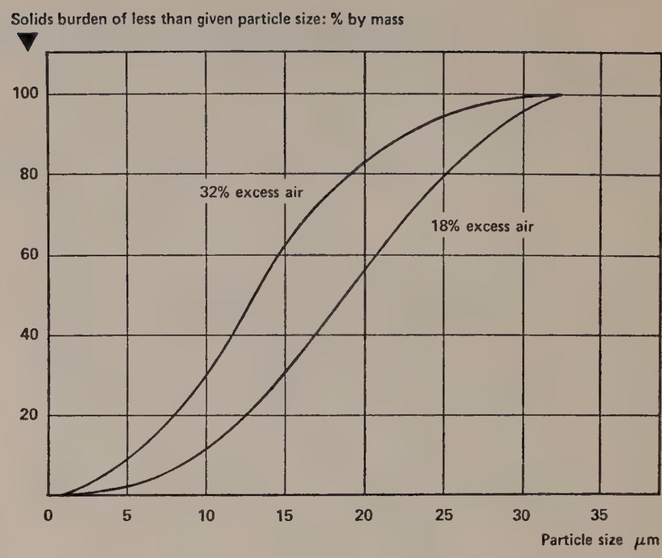

Fig. 2 Unburnt Solids from 6 t/h Boiler: Particle Size Distribution

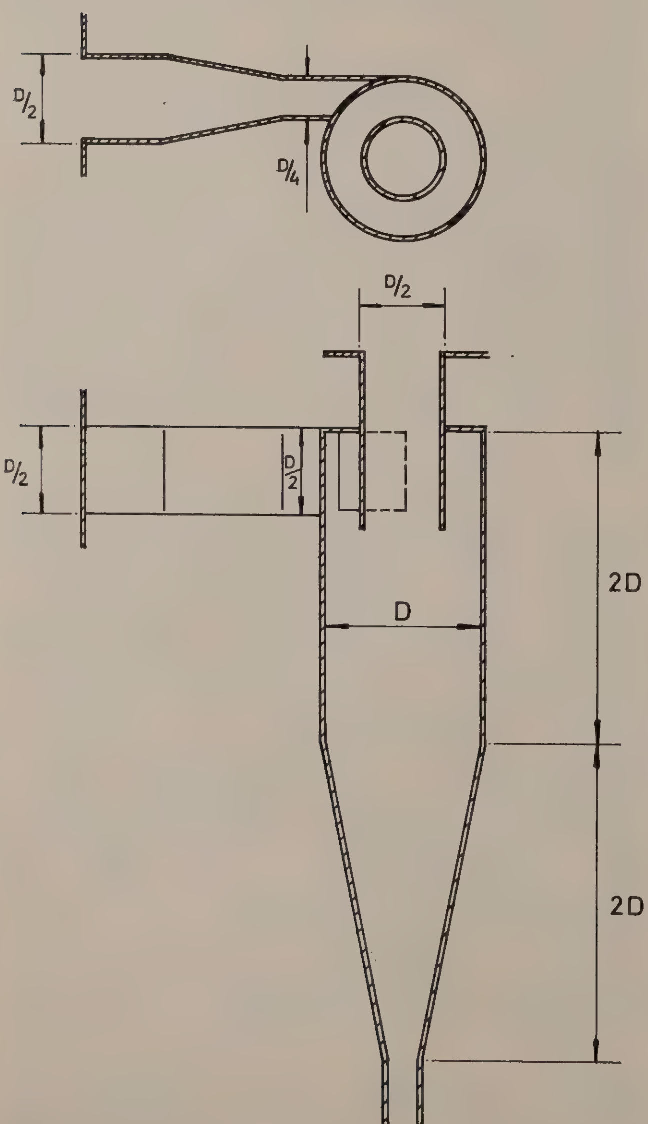

Fig. 3 The Ter Linden Cyclone

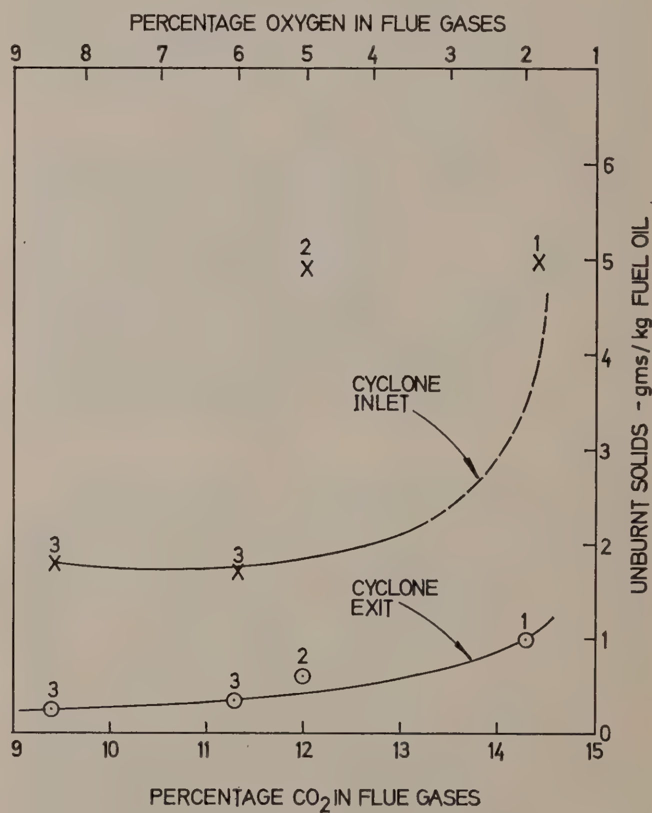

Fig. 4 Cyclone Characteristics. Unburnt Solids in Flue Gases

TABLE 1

F.E. BEAUMONT LIMITED GAS SOLIDS COLLECTOR TRIALS AT GILLETTE INDUSTRIES, READING

Trial No	Boiler		Fuel Flow Rate		Gas Analysis		Flue Gas Temperature	Pressure mbar		Unburnt Solids		
										Fuel g/kg		Cyclone Collecting Efficiency
	No	Load	kg/h	gal/h	Oxygen %vol	Carbon Dioxide %vol	°C	Cyclone Inlet	Cyclone Exit	Cyclone Inlet	Cyclone Exit	%
1	3	High	254	58.8	8.5	9.4	210	+2.5	-2.25	1.8	0.26	86
2	3	Low			9.0	9.0	150	-0.5	-0.8	1.0	0.29	71
7	3	High	261	60.5	6.0	11.3	205	+2.5	-2.5	1.7	0.35	79
8	3	Low			8.0	9.7	140	-0.6	-1.0	0.65	0.50	23
3	2	High			5.0	12.0	251	+0.8	-2.3	4.9	0.60	88
4	2	Low			17.0	-	179	Too much excess air				
5	1	High			2.0	14.3	300	+0.8	-2.1	5.0	1.0	80
6	1	Low			5.0	12.0	Test abandoned due to boiler tube water leak					

design to ensure adequate mixing of the fuel with the primary and secondary air and by developments of controls to ensure that at all times and at all boiler loads the air-fuel ratio is correct for adequate combustion and optimum efficiency.

Dust particles produced with oil-firing consist of chars or cokes made up of partially burnt or carbonised particles of fuel. They have a sponge-like appearance and are spherical in shape. They generally form more than 80 per cent of the emission on a mass-basis. A particle size distribution curve of a sample of this type of dust is shown in Figure 2. The size and characteristics vary from plant to plant but, in general, burners that give a high percentage of unburnt particles give a higher percentage of the large particles. Conversely, well designed burners give a low percentage of unburnt solids and the concentration of finer particles increases in proportion.

Over 90 per cent of the dust particles consist of particles greater than 5 microns diameter, consequently a high proportion can be arrested by a simple grit arrestor such as a conventional cyclone. Furthermore, the cyclones should be more efficient when fitted on an oil-fired plant which gives a high output of unburnt particles due to poor atomisation, because the percentage of large particles will be higher. Allowing for the small concentration of smoke present in the flue gases, a simple cyclone fitted to a typical package boiler or other oil-fired plant should in theory ensure that the emission from the plant is well below 1·0 g/kg fuel oil consumed.

Considering the design of a grit arrestor for oil-fired plant it was thought that it must meet the following requirements:

(a) The design must be simple.
(b) The unit must be compact.
(c) The unit must operate so that metal surfaces in contact with the flue gases are maintained above the acid dewpoint.
(d) The pressure loss across the cyclone at maximum throughput should be below 5 mbar (50 mm wg) in order to minimise the extra fan power required.
(e) The unit should be designed to ensure that the particulate emission to the atmosphere is maintained below 1·0 g/kg fuel oil consumed.
(f) The plant should be designed to be as inconspicuous as possible.

It is now common practice to use multi-flue chimneys and it was thought that requirements (c) and (f) could be met if the cyclone arrestor was fitted inside the chimney shell.

A standard design of cyclone, the Ter Linden, Figure 3, is widely used and a cyclone of this design could readily be fitted within the chimney. The pressure loss across this type of arrestor is, however, normally 10-15 mbar at maximum throughput and this would be too high for our requirements. It was decided, therefore, to modify the design to achieve a pressure loss of not more than 5 mbar and to determine whether this could be achieved without an appreciable loss in collecting efficiency.

Different designs were considered by BP Research Centre in co-operation with Messrs F. E. Beaumont and several small prototype models were manufactured and tested in the laboratory. A design was developed which was considered to have an adequate collecting efficiency, reducing the solids emission from a test burner to below 0·4 g/kg of fuel at high throughput. The inlet dimensions were modified and an internal helical baffle fitted so that it operated with a maximum pressure loss of 5 mbar but the external measurements of the cyclone were not changed.

Field Trial of the Prototype Cyclone

The successful laboratory design was then incorporated in a field trial unit and fitted to a John Thompson package steam boiler with a Hamworthy rotary cup burner. The boiler capacity was $1 \cdot 36 \times 10^3$ kg steam/hour (3×10^3 lb/hour) and the fuel consumption 88 kg/hour (21 gallon/hour). The cyclone operated satisfactorily for over a year with a maximum pressure loss of 5mbar and a collecting efficiency of 66 per cent. The emission was 0·8 g/kg fuel oil at maximum throughput.

The laboratory and field trials have been described in the Journal of the Institute of Fuel (7).

Trials on the First Commercial Unit

Several full scale units have been installed on BP's own boiler plant but the first commercial unit was installed in Reading at Gillette Industries Limited in 1976. The boiler house contained three Parkinson Cowan GWB Powermaster hot water boilers. Boiler Nos 1 and 2 were designed for a maximum output of 2·63 MW (9 million Btu/hour) and Boiler No 3 for an output of 3·43 MW (11·7 million Btu/hour).

The arresting plant consisted of three cyclones installed in the base of the chimney, each connected to one of the boilers and each venting into a chimney liner. All the cyclones had the same dimensions and were designed to be suitable for the largest boiler ie No 3. It was considered that the two smaller boilers may be replaced in the near future with larger boilers with capacities similar to Boiler No 3.

The results of the trials are shown in Table 1. Figure 4 shows in graphical form the solids emission data at the inlet and exit from the cyclones fitted on Boiler Nos 1, 2 and 3 when firing heavy fuel oil of nominal viscosity 3500 Red I seconds at 37·8°C (100°F).

Results from Commercial Cyclone Evaluation

1. The boilers were in general operating with too much excess air except in Trial No 5. This resulted in a higher pressure loss for a given boiler load than would be obtained if the plant was operating at the designed excess air levels. In Trial No 1, for example, the flue gas throughput in Boiler No 3 was equivalent to the boiler operating at its maximum designed load. The pressure loss across the cyclone was 4·75 mbar which is very close to the designed pressure loss of 5 mbar.

2. The dust arresting efficiencies were higher than indicated in the laboratory and prototype trials. Even when the oxygen content of the flue gases was reduced to 2·0 per cent (14·3 per cent carbon dioxide in the flue gases) the emission was only 1·0 g/kg fuel oil. This emission level is well within all European and American maximum emission levels and was obtained under the most severe conditions likely to be encountered in practice.

3. The boilers used in this plant required to be adjusted and maintained in operation with optimum flue gas conditions, that is $3 \cdot 5 \pm 0 \cdot 5$ per cent oxygen in the flue gases ($13 \pm 0 \cdot 5$ per cent carbon dioxide in the flue gases). The new system allows boiler operators to adjust their plant to operate at economical air/fuel ratios without exceeding permissible levels of particulate

emissions and at the same time to reduce fuel consumption.

4. In conventional boiler systems the boiler operates under slight negative pressure due to the induced draught from the chimney. With this system, when the plant is operating at maximum throughput, the draught from the chimney is taken up by the pressure loss across the cyclone. Therefore, the boiler plant is under slight pressure instead of slight suction. This has the advantage of eliminating cold air infiltration but it is essential to ensure that door seals are gas tight to avoid the leakage of flue gases into the boiler house.

5. The cyclones are lagged with 50 mm thick slag wool blankets, similar to the lagging used on the chimney liners, and the heat loss is further reduced by the cyclones being within the chimney shell. This ensures that when a boiler is brought on line the metal surfaces of the cyclones are rapidly raised to a temperature above the acid dewpoint and maintained above this temperature during the rest of the boiler's operating period. In the long trial of the prototype unit there was no evidence of corrosive or abrasive wear in the cyclone.

As well as effectively reducing atmospheric pollution it will be observed that the unit has satisfactory aesthetic characteristics.

Conclusions

1. Flue gas particulate emissions from conventional packaged boilers can be reduced below 1 g/kg of fuel by the use of specially developed cyclone equipment. These enable existing EEC and USA legislative limits applying to packaged boilers to be complied with.

2. Development work on cyclones through the laboratory and field trial prototype stages has successfully culminated in the manufacturing and marketing of commercial Gas Solids Collectors (GSC) by F. E. Beaumont Limited.

3. Results obtained during evaluation of the first commercial GSC unit have shown that collecting efficiencies of up to 88 per cent can be achieved with a design pressure drop across the cyclone of less than 5 mbar.

Acknowledgements

The authors wish to acknowledge the co-operation and support they have received from the staff of Gillette Industries Limited, F. E. Beaumont Limited, Parkinson Cowan Boilers, John Thompson Boilers Limited and BP Research Centre staff in the course of these investigations. Permission to publish this paper has been given by the British Petroleum Company Limited.

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SMOKE CONTROL AREAS

Progress Report
Position at 30th June 1977

(Figures supplied by the Department of the Environment, The Welsh Office, the Department of the Environment for Northern Ireland and the Scottish Development Department).

	England			Wales			Scotland			Northern Ireland		
Smoke Control Orders Confirmed prior to 31.3.77	4,744			21			252			73		
Acres		1,571,090			2,912			137,112			17,607	
Premises			6,864,019			10,499			575,700			48,044
Smoke Control Orders Confirmed (31.3.77-30.6.77)	70			3			4			2		
Acres		41,389			50			932			786	
Premises			123,108			255			2,981			4,176
Totals	**4,814**	**1,612,479**	**6,987,127**	**24**	**2,962**	**10,754**	**256**	**138,044**	**578,681**	**75**	**18,393**	**52,220**
Smoke Control Orders Submitted (31.3.77-30.6.77)	15			—			1			—		
Acres		4,040			—			188			—	
Premises			16,785			—			71			—
Grand Totals	**4,829**	**1,616,519**	**6,993,912**	**24**	**2,962**	**10,754**	**257**	**138,232**	**578,752**	**75**	**18,393**	**52,220**
Smokeless Zones (Local Acts) in Operation ..	44			—			—			—		
Acres		3,400			—			—			—	
Premises			41,060			—			—			—

New Smoke Control Orders

The lists below are supplementary to the information in the last issue of **Clean Air (Summer 1977)** *which gave the position up to* **31 March 1977.** *They now show changes and additions up to* **30 June 1977.**

Some of the areas listed are new housing estates, or areas to be developed for housing. The total number of premises involved will therefore increase. An asterisk denotes that there have been objections and that a formal inquiry has been or will be held.

The list of new areas in operation of smoke control is based on the plans submitted to the Department of Environment, but may erroneously include some local authorities who have made postponements, without notifying the Ministry of the fact.

ENGLAND

NEW SMOKE CONTROL ORDERS IN OPERATION

Northern
Langbaurgh No. 3 (Grangetown North); Newcastle upon Tyne No. 2 (Castle Ward) Nos. 8 and 9 (Gosforth) Nos. 22 and 23 (Newburn) and Nos. 23-25.

South Eastern
Gravesham No. 2.

NEW SMOKE CONTROL ORDERS CONFIRMED BUT NOT YET IN OPERATION

Northern
Carlisle No. 5; Castle Morpeth No. 1; Darlington B.C. No. 16 (Cockerton) and No. 17 (Haughton); Gateshead, Teams No. 6; Langbaurgh No. 2 (Hunters Hill); Middlesbrough No. 23 (Newport Rd./Stockton Rd.) No. 26 (Marton Grove) and No. 27 (Albert Park); Newcastle upon Tyne No. 10 (Gosforth) No. 24 (Newburn) and Nos. 26-29; N. Tyneside No. 1; Sedgefield No. 7 (Newton Aycliffe).

North Western
Hyndburn No. 38; Pendal D.C. No. 1 (Barnoldswick) and No. 9 (Colne); Trafford B.C. No. 1 (Bowdon/ Bucklow); Vale Royal D.C. No. 1 (Manchester Rd.); Wigan B.C. No. 2 (Ashton in Makerfield) and No. 6 (Tyldesley).

Yorkshire & Humberside
Barnsley M.B. No. 1 (Upper Cudworth) No. 2 (Lower Cudworth) No. 3 (Ardsley) No. 4 (Barnsley Barugh) No. 9 (Thurnscoe) No. 10 (Darfield) No. 11 (Monk Bretton) and No. 12 (Old Mill); Caldersdale M.B. No. 2 (Ripponden/Rishworth); Craven D.C. No. 2 (Glusburn Part I); Rotherham M.B. (Kimberworth Holmes) and (Thorpe); Wakefield No. 1 (Featherstone) No. 2 (S. Kirkby) No. 9 (Knottingley) and (Middlestown).

West Midlands
Coventry Nos. 19 and 20; City of Stoke-on-Trent No. 33; N. Warwickshire No. 3; Warwick D.C. Nos. 7 and 8.

East Midlands
Amber Valley No. 4 (Whitemoor and Belper); No. 5 (Alfreton Park, Alfreton) and No. 6 (Bailey Brook, Heanor); Bolsover D.C. (Pinxton and S. Normanton); Chesterfield No. 10 (Brampton and Boythorpe); Gedling No. 5; Nottingham No. 8b.

South Eastern
Dartford No. 16; Gillingham No. 9; Gravesham No. 3; Guildford No. 4; Milton Keynes No. 3 (Bletchley No. 6); Thurrock Nos. 13 and 14.

London Boroughs
Bromley Nos. 30 and 31; Hillingdon Nos. 31 and 33; Kingston upon Thames No. 26; Lambeth Nos. 31-35.

NEW SMOKE CONTROL ORDERS SUBMITTED BUT NOT YET CONFIRMED

Northern
Derwentside (Burnopfield No. 2) and (Annfield Plain No. 2).

North Western
S. Ribble Nos. 4 and 5; Stockport No. 19 (High Lane); W. Lancs. No. W.L. 3.

West Midlands
Coventry No. 20; Nuneaton No. 16 (Exhall); N. Warwickshire No. 3; Wolverhampton No. 22 (Merry Hill and Penn Fields).

East Midlands
Ashfield No. 5; Bassetlaw D.C. (Worksop No. 7A Kilton Forest); Mansfield No. 4.

South Eastern
Watford Nos. 16 and 17.

NORTHERN IRELAND

NEW SMOKE CONTROL ORDERS IN OPERATION

Belfast C.C. No. 10 (Var.) and No. 13.

NEW SMOKE CONTROL ORDERS CONFIRMED BUT NOT YET IN OPERATION

Belfast C.C. No. 13A; Castlereagh D.C. No. 4.

SCOTLAND

NEW SMOKE CONTROL ORDER IN OPERATION

Hamilton District
Hamilton No. 5.

NEW SMOKE CONTROL ORDERS CONFIRMED BUT NOT YET IN OPERATION

City of Edinburgh District
St. Bernard's.

Nithsdale District
Georgetown South; Lochside South.

Strathkelvin District
Torrance West.

NEW SMOKE CONTROL ORDER SUBMITTED BUT NOT YET CONFIRMED

Strathkelvin District
Torrance West.

WALES

NEW SMOKE CONTROL ORDERS CONFIRMED BUT NOT YET IN OPERATION

Wrexham Maelor B.C. Nos. 3, 4 and 5.

SMOKE CONTROL ORDER WITHDRAWN

West Midlands
N. Warwickshire No. 3.

The energy needed to reduce external air pollution from the iron castings industry

by

Dr K. S. B. Rose
(Energy Technology Support Unit, AERE, Harwell)

INTRODUCTION

Reduction of external air pollution from iron foundries is a desirable environmental objective and legislation is proposed to set upper limits for emissions from certain types of foundry melting equipment. But reducing pollution creates other problems such as increased capital cost and increased energy consumption. The scale of these increases needs estimating in order to put the benefits into perspective, and this paper shows how an estimate was made of the increase in energy needed to fulfil existing and proposed legislation. The increased capital cost has already been estimated[1] as £60 million (1974) and the financial strain that this imposes on the Iron Castings Industry can be appreciated when it is set against current total annual foundry investment of about £20 million (1974). Selling costs of iron castings are likely to be increased by at least 2-4%.

In order to estimate the increased energy consumption, the following three areas need examining:

(a) nature of the pollution (section 1.1);
(b) relevant Laws and Proposals (section 1.2);
(c) equipment available (section 1.3).

First, however, the Iron Castings Industry and its cupolas are briefly described.

The Iron Castings Industry is a key industry in the UK since most of its products are inputs to other important manufacturing industries, such as motor cars and steel making. It plays an important ecological role in turning low grade iron and steel scrap into usable products; each tonne of casting contains an average of 0·78 tonne of scrap, and approximately 22% of UK ferrous scrap production is consumed by iron foundries.[2] Use of low-grade scrap removes the problem of disposal of old cars etc from the general environment but causes local air pollution problems at the foundry. In addition to direct pollution from material on the scrap (for example, paint and oil), the materials used in melting the scrap can contribute to air pollution; coke is friable and limestone potentially dusty. These problems are compounded by the high temperatures and large air volumes used in the melting process.

The main pollution to the outside environment of most foundries comes from the cupola, which is a vertical stack melting furnace that has air injected at a position close to its base. A mixture of iron, coke and flux is fed into the stack through a charging door close to the top. The air burns the coke as it approaches the base and the resulting heat melts the iron. The combustion gas coming out of the top of the bed of material in the cupola is termed 'top gas'. Typically 1060 kg of 'top gas' is produced per tonne of iron melted,[3] its temperature depends on the depth of bed material through which it has passed and can vary between 250-700°C.[4]

Quantity, composition and temperature of top gas change as it passes the charging door, owing to the influx of air, and the gas becomes known as 'exhaust gas'. The volume of exhaust gas depends on the amount of natural draught in the cupola stack and on size of the charging door. Measurements on 35 cupolas gave exhaust gas volumes 2-4 times those of the top gas,[3] therefore the mass of exhaust gas from a cupola is likely to be in the range 2-4 $\times$ 10^3 kg/tonne of molten metal (2·3-4·6 $\times$ 10^3 m^3 at 20°C). The change in temperature of the gas depends on whether the carbon monoxide in the top gas burns. If it does the temperature increases to 400-800°C; but, if not, the temperature is lowered to 80-350°C. A large rise in temperature occurs when cupolas are being emptied at the end of their melting cycle. The smaller amount of charge material in the cupola does not absorb as much heat from the bases as they rise from the melting zone and top gas temperature can rise to 800-1000°C. The inevitable combustion at the charging door that occurs at these temperatures makes the exhaust gas even hotter unless a large excess of air is introduced.

The practical consequences for the gas cleaning system (collector) are that it must be able to cope with

(a) abrasive, corrosive gas;
(b) gas flow-rate fluctuations, due to changes in cupola bed porosity;
(c) wide variations in gas temperatures, from 20°C to at least 1000°C.

The gas can be cleaned when it is either top gas or exhaust gas. Normally the exhaust gas is cleaned, despite the higher energy consumption of the collector due to the larger volume of gas being cleaned, because it is simpler.

Most cupolas have a cold air blast but recuperative hot-blast ones are operated. Construction of the two is basically similar but the top gas is usually cleaned in the latter type.

There are over 900 cupolas in the UK but many are operated as pairs, one being maintained while the other is melting, thus less than 900 collectors are necessary.

1.1 Nature of Emission from Cupola Melting Furnaces

Emissions comprise particulates (metallurgical fume, dust and grit), sulphur dioxide, carbon monoxide and smoke. Some of these control the visual appearance of the cupola plume.

Three parameters are used to characterise *particulate matter* emitted from cupolas—quantity, size distribution,

and composition—the first is mainly a function of the other two. The quantity of particulate is likely to lie in the range 4·5-23 kg/tonne of iron melted;[4] the typical value often quoted is 9 kg/tonne of iron melted. There is no significant difference between hot and cold-blast cupolas.

The sizes of particles lie mainly between 0·1-1000 μm, hot-blast cupolas produce a greater proportion of fine particles (metallurgical fume). The size distribution frequency of particles is almost unique to cupola furnames; most samples have three or four maxima in the ranges 100-200 μm, 20-50 μm and 2-5 μm.

The range of chemical compositions is listed below. With the exception of the combustibles, the list consists of metallic oxides characteristic of pyrometallurgical processes. The combustibles are mainly carbonaceous matter from coke.

Substance	*% of Total Mass*
SiO_2	9·3–39·9
$FeO+Fe_2O_3$	11·3–43·0
CaO	1·9–13·4
ZnO	2·3–9·2
Al_2O_3	2·3–9·6
MnO	0·3–5·7
S	0·8–6·4
Combustibles	5·0–39·9

Some Constituents of Cupola Particles (5)

In practical terms metallurgical fume and smoke are the most difficult particulates to remove from gas and are of special importance because they determine the visual opacity of the plume; particles in the size range 0·4-0·8 μm cause maximum light scattering.[6] They give the visual impression that the cupola is 'smoking'. Actually these very fine particulates are only about 10% of the total mass, more than 50% is coarse (greater than 63 μm) and is easily removed. Since current designs of collector separate fine particles least efficiently, up to 90% of particulate matter can be removed from the exhaust gas and the plume appearance will remain unaffected because the 10% left in the gas contains all the metallurgical fume. Thus the visible source of air pollution from a foundry, the cupola plume, is a misleading indicator of the amount of particulate being released. Furthermore, if a wet collector is fitted there will be a dense white plume even if all particulate matter is removed, because of water vapour in the cleaned gas.

Smoke is generated if a cupola is charged with material containing oil, grease, etc because the reducing atmosphere in a cupola prevents complete combustion. Much of the scrap is contaminated in this respect but smoke is eliminated, together with carbon monoxide, if combustion occurs at the charging door.

Top gas contains 12-25% *carbon monoxide*. The amount increases with the proportion of coke in the charge and with any decrease in combustion efficiency. Combustion at the charging door oxidises carbon monoxide to carbon dioxide and also removes smoke and some of the combustible fraction of the particulate emission.

Coke burnt in UK cupolas contains about 0·8% *sulphur* and half, or more, of this enters the metal being melted. The rest is mainly emitted as sulphur dioxide in the gas, at levels between 20-250 ppm.[7] About a third of this will be absorbed by the water[8] if the cupola is fitted with a wet collector. The remaining sulphur dioxide is discharged and its concentration is used as a means of determining chimney height.[9]

Thus particulate matter is the main pollutant that has to be removed if combustion occurs at the cupola charging door.

1.2 UK Laws and Proposals concerned with Environmental Control External to Iron Foundries

Legislation has evolved from a number of Acts and applies to individual processes. Relevant sections of legislation are to be found in the following Acts etc:

Clean Air Act;[10]
Ministry of Housing and Local Government recommendations on cold-blast cupolas (1968);[11]
Works Order from Alkali Inspectorate—directive 8/68;[12]
Report on Second Working Party on Grit and Dust Emission (1974).[13]

The requirements in an energy context are summarised in the Appendix.

1.3 Equipment Available to Meet Improved Standards

Collectors suitable for cleaning cupola gases can be classified into four main groups.

(a) Dry mechanical collectors (inertial collectors)—eg settling chambers, high efficiency and nested-tube cyclones.
(b) Wet scrubbers—eg wet arrestors, spray towers, jet impingements, fluidised beds, irrigated targets, self-induced sprays, Venturi throats, flooded discs and disintegrators.
(c) Filtration cleaners (fabric cleaners)—eg reverse jets.
(d) Electrostatic collectors—eg dry and wet.

Collectors from the last three groups can be designed to remove all grit and dust and most metallurgical fume from cupola gases. Dry mechanical collectors are unable to remove fine dust and fume. There are no cheap, low power collectors capable of removing sub-micron sized particles from a gas stream. To collect such material the equipment must be either large or use a great deal of energy to make the particles move more quickly. High efficiency centrifugal collectors (disintegrators) can impose accelerations up to 10^3 g on particles with corresponding reductions in the physical size of the equipment, but only at the expense of considerable power consumption.

Choice of collector type is a complex issue of capital costs, operating costs, maintenance costs, and particular preferences on the part of intending purchasers. The UK preference is for wet scrubbers in the high efficiency equipment; other countries have different preferences.[14] All four classes of collectors are well proven and widely used in other industries.

Actually only about 30 out of 900 UK cupolas are fitted with high efficiency collectors, about half of the total have low efficiency wet arrestors and a third have the very low efficiency dry arrestors.

The implications of all the regulations have been considered by F. Shaw[4] and his selection of collectors likely to be installed is summarised below:

Hot-Blast Cupolas		*Cold-Blast-Cupola*			
		1968 Recommendations		*1974 Proposals*	
Size	*Collector*	*Size*	*Collector*	*Size*	*Collector*
All sizes	High efficiency scrubber	⩽3 ton/hr	Dry arrestor	⩽3 ton/hr	Wet arrestor
				3–7 ton/hr	Multicyclone
		>3 ton/hr	Wet arrestor	7–10 ton/hr	Medium efficiency scrubber
				>10 ton/hr	High efficency scrubber

There is doubt concerning the wisdom of fitting medium efficiency scrubbers and Shaw[4] considers that opinion appears to be hardening in favour of either cheaper, simpler plant of lower efficiency (wet arrestors) or very much more expensive, but highly efficient, plant capable of cleaning the gases to the limit of visibility (for example, high efficiency scrubbers).

2. ESTIMATE OF ADDITIONAL PRIMARY ENERGY CONSUMPTION

Energy is needed not only to operate collectors but to make their materials, to install and to maintain them.

An accurate calculation of the energy sequestered in capital and maintenance materials needs a detailed knowledge of equipment design and individual foundry conditions. The difficulty is overcome if it is assumed that the energy sequestered is proportional to the financial cost and then converting cost to an energy value by means of a conversion factor—0·15 GJ_t/£(1968). Most industrial processes involved have energy requirements between 0·11 and 0·18 GJ_t/£(1968); 0·15 was selected as being typical. Clearly the energy values calculated for construction, installation and maintenance cannot be very accurate, but this is of little importance since they are usually relatively small compared to the energy consumed in operating the collector.

Thus the energy used by collectors can be calculated from the electrical energy needed to operate them and the capital and maintenance cost of the collectors. Two information sources are used:

(a) Shaw's data. F. M. Shaw of British Cast Iron Research Association is an acknowledged expert in air pollution from cupolas and has compiled his own, unpublished, information on cost and performance of actual collectors installed on cupolas which he kindly made available for this study.[15] This information is certainly the most relevant to UK conditions, but because of emphasis on wet scrubbers in this country there are no recent data on filtration cleaners and electrostatic collectors.

(b) Engels and Weber's data. G. Engels and E. Weber[16] published a comprehensive book dealing with cupola emission control. This provides the most recent information for proportioning capital costs, maintenance costs, and operating power consumption of electrostatic collectors and filtration cleaners to those of wet scrubbers. Information in Table 23 of their book is used. The electrostatic collector and filtration cleaner selected have relatively low cleaning efficiencies for these types of equipment and are chosen so that they have a similar performance to the Venturi scrubber.

The information from Shaw and Engels and Weber are combined and plotted in fig 1 against collector efficiency on 1 μm dust. It can be seen that the wet electrostatic collector has the lowest energy requirement for high efficiency cleaning; it consumes only a third of the energy needed by the Venturi scrubber.

The information in fig 1 is combined in Table I with the preferred choice of collectors (section 1.3), and the number of cupolas, to calculate total energy of $3 \cdot 3 \times 10^6$ and $5 \cdot 6 \times 10^6$ GJ for 1972 and 1983. The first year, 1972, is a hypothetical case for the latest year in which a complete cupola survey was performed; 1983 is the first year in which proposals might be fully implemented (Appendix I). The following notes explain the method of calculation and assumptions used:

(a) The annual energy requirement is calculated by adjusting the rate of energy consumption in fig 1 to the mean cupola size and then multiplying by the average number of hours per annum and the number of cupolas.

(b) The numbers of cold-blast cupolas in 1972, and their average hours of operation, listed in Table I, are based on a special census made by the Council of Ironfoundry Associations.

(c) The number of hot-blast cupolas in 1972 is decreased from 40 to 27 because of the new Alkali Inspectorate definition that hot-blast cupolas have a minimum air blast temperature of at least 400°C.

(d) The 1983 values are extrapolated from the 1972 values by extrapolating growth values predicted by the NEDO report[17] on the Iron Castings Industry.

(e) Two historical trends in cupola usage are considered. The amount of iron melted in hot-blast cupolas has increased considerably in the past 20 years, but this seems to have halted and so the same growth rate is applied to cold and hot-blast cupolas. An allowance is made for the likely continuing decrease in the number of small relative to large foundries.

So far only collection of particulate matter has been considered, but hot-blast—and probably cold-blast—cupolas will be required to maintain combustion of exhaust gas[11, 12] before discharge because this eliminates smoke and carbon monoxide. Combustion above the charging door occurs spontaneously in some cold-blast cupolas, but it has to be maintained by providing a flame from an afterburner in others. The need for an afterburner depends on the proportion of coke in the charge,[18] as shown below:

	% coke in charge		
	<11	11–14	>14
Spontaneous combustion above charging door	No	Some-times	Usually
Ability of afterburner to maintain combustion	Diffi-cult	Usually	Always

TABLE I
Primary Energy Needed for Recommended Types of Collectors

Cupola Type	Cupola Size, t./hr	Mean hrs used per year	Number of cupolas 1972	Number of cupolas 1983	Type of collector	Annual Energy Consumption GJ × 10³ 1972	Annual Energy Consumption GJ × 10³ 1983
Cold-blast	⩽3 (mean size 2)	743	220	148	Wet arrestor	8·1	5·1
	>3⩽7	1251	571	383	Multicyclone	602·9	404·4
	>7⩽10	1575	50	188	Venturi	274·3	1013·4
	>10 (mean size 23)	2122	100	178	Venturi	2000·1	3560·2
Hot-blast	All sizes (mean size 16)	2344	27	39	Venturi	414·9	605·6
					TOTAL	3300·3	5606·7

TABLE II
Potential Annual Energy Saving Resulting from Choice of Minimum Energy Collectors

Year	Cold-blast Cupola ⩽3 t./hr	Cold-blast Cupola >3<7 t./hr	Cold-blast Cupola >7⩽10 t./hr	Cold-blast Cupola >10 t//hr	Hot-blast cupola	Afterburner
	Wet arrestor	Multicyclone	Multicyclone	50% of Wet Scrubber +50% Wet Electro-static Collector	Dry Electrostatic Collector	
1972	0	0	161 × 10³ GJt	649 × 10³ GJt	222 × 10³ GJt	352 × 10³ GJt
1983	0	0	607 × 10³ GJt	1156 × 10³ GJt	324 × 10³ GJt	428 × 10³ GJt

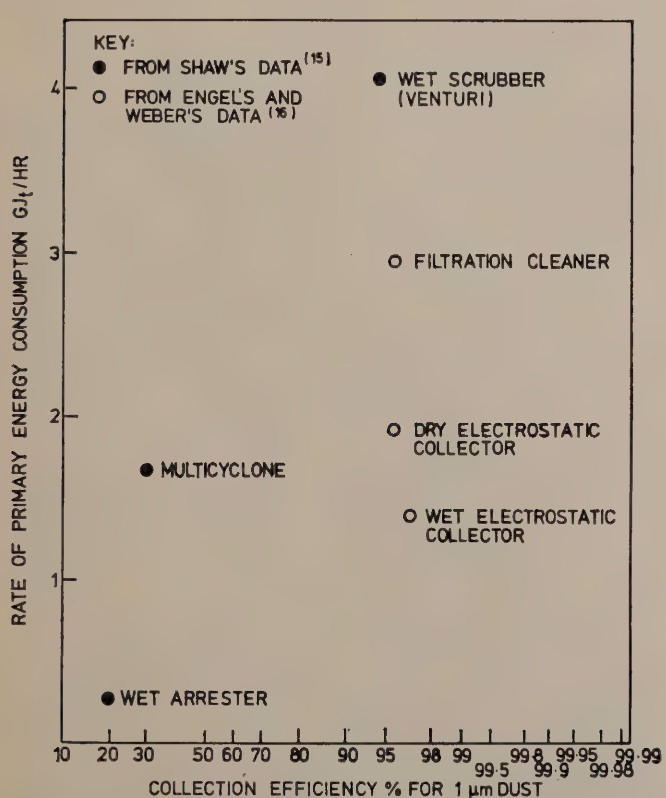

Fig. 1 Total Energy used by Collector versus Efficiency of Collector

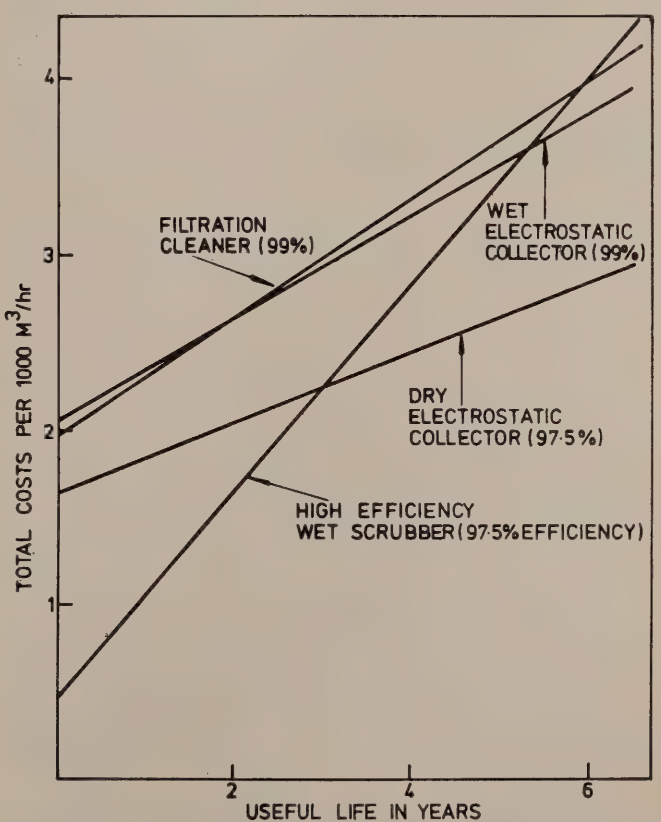

Fig. 2 Cost comparisons of various types of Dust Collectors (based on Fig. 85 in Ref. 16)

F. Shaw estimates that approximately half the total number of cupolas will need afterburners.[15] Total energy consumption for afterburners is calculated using the data in Table I for the numbers of cupolas and mean numbers of hours and the fact that an oil-fired burner uses 18-36 l/hr.[4, 18] Using an average value of 27 l/hr produces annual energy consumptions of 700 and 850 × 10^3 GJ_t/year for 1972 and 1983 respectively. The energy sequestered in materials used for making afterburners is insignificant (the installed capital cost[18] of an oil-fired one is £800 (1970)).

Summing the energy consumptions of collectors and afterburners gives values of 4 × 10^6 and 6·5 × 10^6 GJ in 1972 and 1983. This will increase the energy needed to make iron castings by about 3%.

The importance of these energy increases when balanced against the external environmental benefits is largely a subjective judgement. Energy savings of at least 5% can be made in the Industry by good housekeeping measures and the next section shows that the energy could in any case be reduced.

3. WAYS OF REDUCING THE EXTRA ENERGY CONSUMED

The above estimate of energy usage is based on the most likely developments in the Industry. Several less likely developments would reduce the usage but before considering them it is useful to show the distribution of the above primary energy consumptions in the different categories.

	Cold-blast Cupolas t./hr				Hot-blast Cupolas	Afterburners
	≤3	>3≤7	>7≤10	<10		
1972	0·2	15·0	6·8	49·8	10·3	17·9
1983	0·1	6·3	16·0	55·1	9·4	13·1

Percentage of Total Primary Energy Consumption for Environment Protection

Clearly the energy used by cold-blast cupolas >10 t./hr dominates the energy use.

3.1 By using Collectors needing Minimum Energy Input

It is possible to reduce the energy requirement by having a different selection of collectors from those in Table I. Considering each range of cupolas separately:

(a) *Cold-blast 3 t.hr.* There is no alternative to the wet arrestor which has a minimal energy requirement anyway (fig 1).

(b) *Cold-blast 3-7 t.hr.* Again there is no lower energy alternative to the multicyclone.

(c) *Cold-blast 7-10 t./hr.* The industry is believed to be considering[4] fitting high efficiency wet scrubbers (for example, Venturi) rather than the medium efficiency collectors (for example, multicyclones). This would increase the energy consumption in Table I because Venturi scrubbers consume twice the energy (fig 1). An extra 161·3 and 606·6 × 10^3 GJ_t/year of energy would be needed, in 1972 and 1983 respectively, if high efficiency wet scrubbers were fitted instead of multicyclones; although cleaning efficiency would be higher. The emission levels from a multicyclone installed on a UK cupola were measured by BCIRA and found to be well within the requirements for cupolas between 4-10 t./hr.[19]

(d) *Cold-blast >10 t./hr and all hot-blast cupolas.* This is the most important group in terms of energy consumption since it will account for 60% of the total.

Present UK preference is for the high efficiency wet scrubber of which there are several types—Venturi, flooded-disc and disintegrator. There is nothing to choose between these types in terms of energy usage since their efficiencies are proportional to the energy put into them. Fig 1 shows that both filtration cleaners and electrostatic collectors use less energy than high efficiency wet scrubbers, but there is no widespread experience of their use on cupolas in the UK.

Each high efficiency collector has advantages and disadvantages relative to other types and choosing between them is complex. Both electrostatic collectors and filtration cleaners were unsatisfactory when first fitted to cupolas, but experience has shown ways of avoiding the problems. The sole electrostatic collector fitted to a UK cupola operates well, and filtration cleaners have been used by US foundries in the Los Angeles area for over 20 years. A comparison of total costs made for Germany in 1967, the days of ‘cheap’ energy, is reproduced in fig 2. It shows that a dry electrostatic collector becomes cheaper to operate than a wet scrubber of the same efficiency after three ‘useful’ years, and that higher efficiency wet electrostatic collectors and filtration cleaners are cheaper after six years.[16] Normal expected life of collectors is roughly 15 years but their ‘useful’ life depends on foundry operations.

Reverting to energy considerations, fig 1 shows that changing from a wet scrubber to another type of high efficiency scrubber saves energy. Several minor energy consumptions are omitted from the calculations; none are likely to affect the conclusions reached, but they are worth noting:

(i) Wet collectors require soda ash, or a similar chemical, to neutralise water acidity. Approximately 15 kg of soda ash/hr, with a sequestered energy of 0·3 GJ, is needed for a 10 t./hr cupola.[4] In addition a filter press, which uses 1·8 GJ/hr for a 10 t./hr cupola,[20] may be required to remove solids from water, and a further small amount of energy, 0·01 GJ/hr, to remove toxic metals (zinc and lead) from waste water.[21]

(ii) Dry electrostatic collectors need a large afterburner to heat the exhaust gas to over 300°C while the cupola is warming up. A 12 t./hr cupola needs a burner using 10 GJ/hr of energy,[22] the total amount of energy used will depend on the method of cupola operation.

Table II lists the optimum combination of collector and cupola to give the greatest energy saving. It is, however, unrealistic to assume that all high efficiency scrubbers can be replaced because the alternatives are physically larger and have higher capital but lower running costs that makes them more economic to operate for long times. Therefore, in Table II 50% is taken as a target for market penetration of wet electrostatic collectors.

The high temperature and low humidity of the cleaned gas from dry collectors makes its combustion in a hot-blast cupola easier; therefore, hot-blast cupolas in Table II are assumed to use dry electrostatic collectors. Table II shows that the energy savings resulting from optimum choice of collector for all cupolas, including those in section 3.2, is $1{\cdot}4 \times 10^6$ GJ_t in 1972 (35% of the total requirement) and $2{\cdot}5 \times 10^6$ GJ_t in 1983 (42% of the total).

3.2 **Afterburners**

It is shown in section 2 that use of an afterburner can be avoided by increasing the proportion of coke in the cupola. Thus, in principle, there is a choice between burning either excess coke or oil (or gas) in the afterburner. This can be quantified using results from a cupola test which showed that combustion was maintained by using either 18 l/hr of oil in an afterburner or an extra 41-61 kg/hr of coke in the charge.[23] The corresponding primary energies are $0{\cdot}78$ GJ_t/hr and $1{\cdot}82$ GJ_t/hr respectively, so from an energy standpoint it is better to minimise the proportion of coke and use an afterburner. However, there may be practical reasons for using a higher proportion of coke.

The energy consumption calculated in section 2 assumes that the afterburner is burning continuously. Energy could be saved by using burners that automatically cut off and on depending on whether the exhaust gas is burning. This would save at least half the energy, that is at least $0{\cdot}4 \times 10^6$ GJ/year. Such a burner is not available on the UK market at present, although it is understood that one was available some years ago in the USA.

3.3 **Energy Saving by Reducing Volume of Exhaust Gas**

Minimising the volume of exhaust gas saves energy because both electric power and capital cost of collectors are proportional to the volume of gas needing treatment.

In practice the volume of exhaust gas from cold-blast cupolas needing treatment varies over a wide range; extreme values of 840 and 1540 Nm^3/min for a 12 t./hr cupola are quoted.[14] Cleaning these gas volumes with high efficiency wet scrubbers needs electric powers of 186 and 600 kW and installed capital costs of £44 $\times 10^3$ and £96 $\times 10^3$ (1975) respectively. The power differences are smaller for filtration and electrostatic collectors and so the importance of the energy saving discussed in this section is proportionately less.

The absolute volume of gas in conventional cold-blast cupola operations increases at two places—as it passes the charging door, and as it is cooled by injection of water or air. There are two ways in which the first increase can be minimised; either gas can be extracted below the charging door, this is normal for recuperative hot-blast cupolas, or the size of the charging door reduced. The former is only practical when a new cupola is being built and although it offers the advantage of presenting the smallest quantity of gas to the collector, the gases contain a considerable proportion of carbon monoxide and the presence of glowing coke particles presents an ignition danger even at low temperatures. If the gas passes the charging door a partial vacuum inside the cupola must be maintained to prevent the gas, which contains carbon monoxide, emerging. Given a minimum partial vacuum pressure, the amount of exhaust gas depends on the size of charging door opening. Most UK cupolas have a central, bucket, charging system which makes a large-sized door necessary; typical sizes are $1{\cdot}4$-$2{\cdot}8$ m^2. Experiments in the US have shown that door size can be reduced to $0{\cdot}2$-$0{\cdot}7$ m^2 using a feeder or chute charger instead of a central, bucket, charging system.[24] This modification is said to reduce the cost of the air pollution equipment by 50-75%. Alternatively, the opening can be closed by swinging doors and in this way the gas can be prevented from emerging from the opening even though the exhaust gas quantity is only 20% greater than the top gas.[16] For conventional operations a minimum increase of 100% is considered a reasonable objective.[25]

The exhaust gases can be cooled by air dilution, water injection, or radiation. The increase in mass of gas to be treated by the collector if it is cooled from 800°C-260°C by the three methods is 170, 16 and 0% respectively.[6] Clearly either water injection or radiation cooling are preferable to air dilution.

Energy savings resulting from minimising the exhaust gas volume are likely to be appreciable but cannot be quantified on a national scale because the present distribution of exhaust gas volume/top gas volume ratios is unknown. Taking the extreme reductions quoted above of 52% in electric power and 75% in capital cost, a Venturi scrubber on a 10 t./hr cupola would require $2{\cdot}2$ GJ_t/hr, an energy reduction of 53%.

3.4 **Removal of Contamination**

The alternative to removing air pollution by collection is to remove its cause—the grease, oil, paint and grit on the charge materials. Since removal of coarse particles from exhaust gases is relatively cheap, both financially and in energy terms, the main interest is in removing the contaminants that give rise to dust and metallurgical fume.

Normally the large variety of contaminant materials makes scrap cleaning difficult, but sometimes cleaning is practised. For example, the Intal drier is used by the secondary aluminium and brass industries to remove oil from machine swarf before melting. Its energy cost is minimised by using heat from the burning oil to evaporate oil in the fresh charge via an air pre-heater. The high capital cost for this type of equipment,[26] £6 $\times 10^4$ (1974) for 4 t./hr, limits its application. The primary energies used for cleaning 1 tonne of scrap are as follows: capital equipment $0{\cdot}02$ GJ, electricity $0{\cdot}05$ GJ, gas $0{\cdot}05$ GJ, and fuel oil $1{\cdot}02$ GJ, giving a total of $1{\cdot}14$ GJ. This is nearly three times the energy needed by Venturi scrubber fitted to an electric melting furnace.

4. **CONCLUSIONS**

(a) The amount of primary energy needed to meet legislation, both implemented and proposed, for air pollution control depends on the types of collectors and afterburners used. The likely amount is 6 $\times 10^6$ GJ/year which is a 3% increase in the total energy needed to make iron castings.

(b) The collectors likely to be used by the iron casting industry will not have the lowest energy consumption. Collectors using less energy would result in a saving of 2 $\times 10^6$ GJ/year.

(c) The wet electrostatic collector is the high efficiency collector requiring lowest energy input.

(d) An extra amount of energy, $0{\cdot}8 \times 10^6$ GJ/year, is likely to be needed for operating afterburners to eliminate carbon monoxide and smoke discharges. This could probably be halved by making the afterburner operate automatically so that it does not burn when there was a flame burning in the cupola.

(e) Further energy savings can be made by reducing the

volume of gas needing cleaning; the amount is difficult to quantify.

APPENDIX I
SUMMARY OF UK LAWS AND PROPOSALS RELATING TO EXTERNAL AIR POLLUTION FROM IRON FOUNDRIES

(a) Clean Air Act 1968 contains several regulations applicable to foundries.

(i) It is an offence to emit dark smoke as defined by shade 2, or darker, on the Ringelmann scale.

(ii) Provision is made for the Minister to define emission limits for different types of furnaces with heating capacities of 55,000 Btu/hr or more and also to require the fitting of smoke density meters.

(iii) Arrestment plant is required on all new solid fuel furnaces burning fuel at a rate of 45 kg/hr (100 lb/hr) or more, and for new furnaces burning liquid or gaseous fuels at rates of $1 \cdot 25 \times 10^6$ Btu/hr or more.

(iv) The Act is extended to control metallurgical fume as well as grit and dust. Fumes are defined as "any airborne solid matter smaller than dust".

It is the responsibility of local authorities to enforce the above regulations.

(b) Ministry of Housing and Local Government recommendations on cold-blast cupolas (1968).

(i) All cupolas must be fitted with a means for minimising grit and dust emission. Wet arrestors should be required on cupolas melting above 5 tons/hr and operating for 500 hr/year or more, whereas dry arrestors should be allowed on cupolas melting up to 3 tons/hr and operating up to 250 hr/year. Between these limits the type of arrestor should be decided by discussion.

(ii) Cupola gases should be exhausted through chimneys of specified height.

(c) Works order from Alkali Inspectorate in 1966—directive 8/68. This controls emission (grit, dust and fume) from hot-blast cupolas. All exhaust gases must pass through a cleaning plant capable of reducing the solid emission to 115 mg/m^3 (0·05 grain/ft^3)—the limit of visibility—before venting to the air through a chimney of prescribed height. Also, all exhaust gas must be burnt before discharge to the atmosphere. There was originally a relaxation of requirements for cupolas less than 7 tons/hr but this was removed by Directive 2/73, which also defines a lower temperature limit of 400°C for the blast air. Hot-blast cupolas with blast temperatures less than 400°C are re-classified as "cold-blast". The Alkali Inspectorate enforces these regulations.

(d) Report of the 2nd Working Party on Grit and Dust Emissions (1974). The following emission limits for grit and dust are suggested to replace the existing cold-blast cupola recommendations summarised above.

In addition it is recommended that above 10 tons/hr metallurgical fume should be included with the grit and dust; that is, a total emission standard should apply.

The terms grit, dust and fume are used in some of the above legislation and imply particulate matter limits. BS 3405 defines grit particles as greater than 76 μm. By inference from the foregoing definitions metallurgical fume consists of particles less than 1 μm in diameter that are non-combustible, so as to exclude carbonaceous smoke.

5. **ACKNOWLEDGEMENTS**

The author wishes to thank Professor F. Roberts and Dr J. K. Dawson for their advice and encouragement during the writing of this paper. Also he wishes to thank Mr F. M. Shaw of British Cast Iron Research Association for his valuable help and advice, without which this paper would not have been possible. The paper is based on a study performed under contract to the Department of Energy but the Department does not necessarily endorse views expressed in the report.

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Melting Rate (ton/hr)	1	2	3	>3<4	4	5	6	7	8
Allowable Emission (lb/hr) of grit and dust	6·6	13·2	19·8	15·7	17·1	18·0	18·9	9·6	20·3

Melting Rate (ton/hr)	9	10	12	13	14	>14
Allowable Emission (lb/hr) of grit and dust	20·9	21·5	22·1	23·1	23·6	+0·5 for each additional ton/hr

INTERNATIONAL NEWS

4TH INTERNATIONAL CLEAN AIR CONGRESS

The 4th International Clean Air Congress was held from 16th—20th May at the Tokyo Prince Hotel, Tokyo, Japan. The Congress was sponsored by the International Union of Air Pollution Prevention Associations and was hosted by the Japanese member Association, the Japanese Union of Air Pollution Prevention Associations.

The conference was extremely well organised and no expense was spared in its presentation. The total cost was of the order of $US 350,000 and the Congress was heavily subsidised by the Japanese Government and industrial institutions. There were about 1100 delegates. There were no plenary sessions as such and no 'keynote' speeches or papers. This was unfortunate as the only times that all delegates had the chance of being together were at the very formal opening session and the closing session. At the opening there were speeches from the Minister of International Trade and Industry, the General Director of the Environment Agency and the President of I.U.A.P.P.A., Mr Shindo. The only other full session was the closing session at which rapporteurs reported briefly on the six technical sessions which, during the week, went on simultaneously.

The six technical sessions covering research, the effects of air pollution on human health, animals and plants, meteorology and the spread of contaminants and law and administration, were well conducted. In all, 273 papers were presented and about 12 minutes were allowed for the presentation of each paper. This meant that there were only about 5 or 6 minutes for discussion of the paper and this, in many cases, was inadequate, although, of course, some papers provoked no discussion at all. The standard of the papers varied considerably; some were very good indeed, while others barely merited inclusion in such a conference. Although for an international conference of this sort it is inevitable that a system whereby individuals are allowed to propose themselves to give papers must be included, it is unfortunate that leading people in the air pollution field from each of the countries represented were not asked to give keynote addresses at plenary sessions and that more time was not allowed for discussion. Of the 273 papers, 71 came from Japan, 61 from the USA, 41 from Germany and the remainder from all the other countries represented. There were six papers from the UK.

All the papers presented have been bound in one large volume and each delegate was given a copy and a bag in which to carry it. Further copies of the papers are available at a charge of £65. A copy has been obtained and is now available in the Society's library. Discussion at the various technical sessions was recorded and it is understood that this will be published in due course.

There was a very adequate programme of technical visits but because of the six simultaneous technical sessions, it was difficult for delegates to get away and so few were able to take full advantage of this programme. Conversations with those who were able to make some of the technical visits gave the impression that Japanese industry had moved a long way in the control of pollution in the last few years. There was also a very good ladies programme and inevitably the ladies saw more of Tokyo and Japanese life than did the delegates! The Congress "Welcome" Reception and the Farewell Party were very well done.

As for the impressions of Japan and Tokyo, perhaps the weather during the Congress was particularly kind. It was bright and sunny with a stiff breeze and there was little evidence of the pollution for which Tokyo is said to be notorious. Hydrocarbon fumes were not evident except on one day in narrow streets in the older part of the business centre. Nevertheless, many of the attendants in the toll booths on the motorways were wearing anti smog masks. It is evident that the Japanese have done a lot and are still doing a lot to reduce pollution. They are spending a lot of money on mathematical models in an attempt to forecast pollution levels but are finding that they are having to spend more money to monitor and find out whether their forecasts have been correct! It could be argued that this money could be spent on reducing emissions at source.

Although there were not very many members from the Society present at Tokyo, it is clear that the Society is held in a very high regard internationally.

Proceedings of the 4th International Clean Air Congress

These Proceedings include 273 papers in 1088 pages of 22 × 30cm, bound in one complete volume. The contents are as follows: Medical & Biological Effects (36 papers); Meteorological & Diffusion of Pollutants (52 papers); Air Pollution Measurement (28 papers), Research & Survey for Pollution (50 papers); Air Pollution Control Technology (55 papers); Air Pollution Control Planning (52 papers). The price is US\$130·00 plus postage (US\$10·00 Seamail, US\$25·00 Airmail). Copies can be ordered through the NSCA at 136 North St., Brighton BN1 1RG, England.

DIARY OF EVENTS

19-22 September
44th Clean Air Conference
Harrogate

12 October (Wednesday)
a.m. Parliamentary & Local Government Committee Meeting

p.m. Technical Committee Meeting
London

18 October
Copy date for Winter issue of 'Clean Air'

27 October (Thursday)
a.m. Conference & Publicity Committee Meeting

p.m. General Purposes & Finance Committee Meeting
London

24 November (Thursday)
Meeting of the Council of the Society
London

OBITUARY

Mrs. M.E. Willison

It is with great regret that we have to announce that Molly Willison died on Tuesday 12th July, 1977.

Mrs. Willison, a former officer in the Women's Auxiliary Air Force and a past employee of the Solid Smokeless Fuels Federation, was for many years a staunch supporter of the clean air movement. She was a member of the Council of the Society for over ten years and a member of the Conference and Publicity Committee where her wise counsel and sometimes caustic wit often enlivened proceedings and will be sadly missed.

Sir John Charrington

It is with great regret that we have to announce the death of Sir John Charrington, who was President of the Society from 1967 to 1969. Sir John, who was born in 1886, was chairman of Charrington, Gardner Locket & Co, Ltd from 1940 to 1964 and President of the Company from 1964 until his death. He was twice President of the Coal Merchants Federation of Great Britain, first from 1930-31 and then from 1947-49 and was Chairman of the Coal Utilisation Council from 1967-68. Sir John was a great protagonist of clean air and a staunch supporter of the Society. He was President at the time of the passing of the 1968 Clean Air Act and his wise counsel in helping to form the Society's approach to this will long be remembered by those who were fortunate enough to be associated with him.

INDUSTRIAL NEWS

Councils Save Money With Kysor Equipment

Local authorities can save money on heavy fuel bills for refuse collection vehicles if they fit Kysor automatic radiator shutters to their vehicles. This is the firm conclusion reached by Oxford City Council's transport superintendent, Mr R. Beesley, who several years ago carried out tests to prove the fuel-saving capabilities of the equipment manufactured by Kysor Industries (GB) Ltd.

Now Kysor shutters, which ensure that the engine operates at its most efficient temperature, are fitted to all new refuse vehicles by Oxford City Council.

Mr Beesley in his experiment in 1972 fitted a Kysor shutter to a new Dennis 13-ton vehicle with a Perkins 6354 engine, but did not fit one to an identical new vehicle. After seven months and the same mileage, the vehicle with the Kysor shutter had used 236 gallons less fuel than the other. Average mpg were 6·84 and 5·10 respectively, an economy of 34%. Mr Beesley's staff also found the first vehicle needed considerably less maintenance over the seven-month period.

"If you can get an engine to run at its optimum temperature all the time, as it will with the Kysor equipment, its life is certainly increased and it will operate at maximum fuel efficiency," he said.

Other benefits noted were increases in cab comfort for drivers because they can draw instant heat in winter from the engine to the cab and immediate demisting facilities. The abnormally high fuel consumption of a refuse vehicle, which has a life of around ten years, is due to low gearing for slow speeds and the many stops and starts it is required to make.

In order to save even more fuel, the tendency these days is for intermittent loading systems to be used. With the continuous refuse loading system the engine has to be run at high revs constantly to operate the hydraulics. Fuel is saved with intermittent loading because the engine is only revved for compressing.

Vehicles used by local authorities are mainly 13/16-ton Dennis or Shelvoke & Drewry. More recently these 16-ton vehicles have been fitted with Mercedes Benz and Leyland engines and cost in the region of £20,000. In Oxford they average 10,000 miles a year and their performance fitted with Kysor shutters

is always first class, according to Mr Beesley. Other authorities who have fitted their refuse vehicles successfully with Kysor units are Bury, Preston, Colwyn Bay, Worthing and Croydon.

In times of economic stringency every local authority should look at methods of improving efficiency, in order to save money. Mr Beesley and his staff are constantly seeking ways of being more efficient. The city council's agreement to the introduction of the Kysor shutter was entirely due to his appreciation of the many advantages. Since then they have paid for themselves many times over in terms of fuel economy and reduced maintenance.

The Kysor shutter, resembling a venetian blind, is mounted directly in front of the coolant radiators, opening and closing automatically to provide instant and positive control of coolant temperature. Once fitted to the vehicle it needs little or no maintenance and provides constant service throughout the vehicle's working life.

Reader Enquiry Service No. **7740**

New Pulse Jet Filters from A.P.C.

The new range of clean access pulse jet dust collectors, introduced recently by the Air Pollution Control Division of Tilghman Wheelabrator Ltd, is creating great interest because of the clean and simple maintenance operation. Two types of Wheelabrator units are available—the CA Series, and the TA Series 10—ensuring a size and type for most requirements.

The principle of pulse jet filtration is that the dust is collected on the outside of the filter tubes. Access for inspection and maintenance on traditional filters is on the dirty side. This is a dirty operation, and in many instances constitutes a health hazard.

But the new range of Wheelabrator units eliminates this problem, incorporating access to the filter bags from the clean side. An added benefit is that dirty tubes are not removed via the clean access chamber but via the hopper access hatch. The new range also eliminates studs, bolts and other fittings—in fact, the removal of the dirty tube is achieved through a unique snap-ring attachment.

The CA Series is a range of clean access modules, where the filter has a completely weatherproof walk-in housing.

The TA Series 10 is a range of smaller clean access modules, but employing the same snap-ring principle of bag changing as the CA Series. The only difference is that the access to the bag and mechanism is through hinged doors in the roof. An additional feature is the use of a dispersal baffle to reduce the dust load on the bags.

Pulse jet filters have replaced conventional filters on many plants, particularly in the process industries. This is because of their ability to maintain a steady exhaust volume through the regular removal of the excess cake of dust from the outside of the filter tubes, achieved by short blasts of compressed air down the inside of the tubes.

The pulse jet range also has a large air-to-cloth ratio, resulting in a smaller plant and a reduction in capital and maintenance costs.

Reader Enquiry Service No. **7741**

NRDC to License Pyrolysis Process

NRDC will be granting to Foster Wheeler Power Products Ltd an exclusive licence for the building and selling of pyrolysis plants using the 'cross-flow' process originating from the Warren Spring Laboratory, Stevenage.

In the cross-flow pyrolysis reactor, solids are fed vertically down through the pyrolysis zone at 350-700°C while hot recirculating gases are passed horizontally through the bed. This leads to a high rate of heat transfer to the material at a low pressure drop and consequently a more compact reactor than those available in the other pyrolysis processes under development or demonstration elsewhere in the world.

The process enables prepared municipal or industrial refuse to be converted by thermal treatment in a closed reactor to useful gas, liquid and solid fuels. Only part of these fuels is required to maintain the process temperature and the remainder is available for disposal to third-party users. Compared to refuse incinera-

tion, in which any energy recovered is as hot water, steam, or possibly electricity, the pyrolysis gas, oil or solid char can be stored more easily against daily or even seasonal variations in energy demand. The pyrolysis plant cost is also likely to be lower than for a comparable incineration plant, mainly due to lower costs for pollution control equipment. A further advantage is that treatment temperature enables a greater proportion of non-ferrous as well as ferrous metals to be recovered from the char.

Early studies by Foster Wheeler Power Products Ltd, NRDC, the Department of the Environment and the Greater London Council of a large-scale demonstration pyrolysis plant at Edmonton have now been abandoned because of capital restraint in the face of escalating project costs.

However, strong interest is now being shown in the pyrolysis process, particularly by the private sector, for the disposal of industrial wastes such as used tyres. A continuous test facility at Foster Wheeler Power Products' Research and Development Centre at Hartlepool has demonstrated the satisfactory conversion of a tyre feed to a fuel oil and char, also available as a fuel.

Because of the favourable plant economics, the process is viable for treating wastes such as tyres, even at scales as low as 4 tonnes/hour. Plants of this size are also expected to find markets for the reduction in volume of municipal refuse without significant production of energy by-products. Additionally, Foster Wheeler Power Products is in discussion with potential overseas partners for applications and further development of a sophisticated 'second generation' pyrolysis process suitable for waste disposal complexes dealing with 1000 tonnes/day or more of mixed refuse. Also, the particular advantages of the Warren Spring Laboratory process for both industrial and municipal wastes are now more evident in view of some of the major problems encountered in the USA with other pyrolysis plants.
Reader Enquiry Service No. **7742**

New Dust Collectors for Powder-handling Applications

Three new dust-collecting units designed to control dust emissions from powder-handling systems have been introduced by Hivent Ltd.

One, called Hi-Sac, is intended primarily as a sack-tipping booth for large process vats and mixing vessels. Fitted at the vessel's charging point, it contains a fan which draws air in throughout the sack-tipping operation, preventing the escape of dust. With minor modifications to the air-intake arrangements it can also collect the dust given off at transfer points between conveyors.

The other two units, Hi-Silo and Hi-Pressure, are for fitting to storage silos of unpressurised and pressurised type respectively. They filter the exhaust air displaced when powdered or granular products are conveyed pneumatically from bulk-delivery vehicles.

Like the standard Hivent dust collectors which they augment, the new units are of modular design, allowing the user to select the best combination of flow and capacity for a particular dust condition. The Hi-Sac version, for example, is available with a choice of four fans with volumes of 14, 28, 57 or 85 m^3/min (500, 1000, 2000 or 3000 cfm) and four interchangeable filter sections with filtration areas of 7·5, 12, 20 or 30 m^2 (80, 130, 220 or 330 sq ft).

During sack-tipping, the fan draws air in through the hinged access door and up through the filter section, where the dense needle-felt fabric of the filter elements retains airborne dust. Closing the access door switches off the fan automatically and can, if desired, start a built-in vibrator motor which cleans the filter elements by shaking them for a preset period.

The non-overloading centrifugal fan discharges through a top outlet, alongside which is a pressure-relief door discharging upwards for safety. This door also serves as an inspection hatch for maintenance of the fan and vibrator motors, and a separate quick-release door gives access to the filter elements. Electrical interlocks prevent opening of either door when the fan is running. The fan chamber is lined with acoustic material, obviating the need for a separate silencer.
Reader Enquiry Service No. **7743**

'Dynaclone' continuous dust filter

Generally, when a highly-priced powdered product is processed in a direct rotary kiln, there is inevitably some loss of fine grains along with the exhaust gases. This effectively limits the product loading of the kiln to a level where these losses are acceptable.

If the exhaust is controlled from a dust viewpoint, there can be two economic benefits. Firstly, the recovered dust can be added to the kiln output to enhance the overall production. And, secondly, recovery of these fine grains may enable the product loading to be increased beyond what was previously the cost effective limit.

Where the material in question is, or will be, covered by the Alkali Act, the relative importance of these economic considerations may become secondary to the need to conform with the terms of the Act.

Such a case is the Actair dust control equipment recently installed by the Via Gellia Colour Co Ltd, of Matlock—a company specialising in the production of iron oxide pigments. At an early stage of production, the iron oxide is roasted in a rotary kiln, the emissions from which will be required to be controlled by 1978. The 'best practicable means' of dust arrestment for the company—whose work is classed as mineral working—will be left to the discretion of the Alkali Inspectorate, who are empowered to fix limits on the permitted level of atmospheric emission to within the range 0·2 to 0·05 grains per cu ft.

Via Gellia have recently installed an Actair International Ltd 'Dynaclone' dust filter which enables the company to comply with these legislative requirements, as well as contributing economic benefits.

The normal operating temperature of the kiln is 200°F, and the 'Dynaclone' can safely cope with temperatures of 300°F. Automatic safety controls on the filter ensure that higher temperature surges are not reached.

The fine iron oxide dust collected on the filter medium is purged with a low pressure reverse air cleaning technique—unique to the 'Dynaclone' filter. This allows continuous operation, if required, without any need to shut down the filter. It also produces less wear than compressed air cleaning, and allows the reverse air flow to be easily pre-heated to avoid the possibility of condensation during abnormal operation of the furnace.

The filter medium in the 'Dynaclone' is in the form of flat bags, with the dust collected on the **outside** of the bags. In this way a large area of filter cloth can be contained in a space up to 50% smaller than alternative configurations—and in this particular application enabled the filter to be sited alongside the furnace, **inside** the building. The disposition of the bags also means that they can all be seen, and easily changed should that be necessary.

The estimated dust loading of the 1500 CFM gas flow from the furnace is 15 grains per cu ft, with particle sizes below 10 microns. The collected dust falls into a hopper for subsequent removal. The complete 'Dynaclone' was prefabricated at Actair International's Cardiff factory, and delivered ready assembled.
Reader Enquiry Service No. **7744**

CLEAN AIR

WINTER 1977
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CLEAN AIR

THE JOURNAL OF THE NATIONAL SOCIETY FOR CLEAN AIR

Vol. 7 No. 27 **Winter 1977**

The Society and its Future

When thinking of the Society, there is a tendency in days of financial constraint to examine its finances and resources. But important as finances are, the Society's profits are not expressed as dividends paid to members, but rather as achievements in helping to make the air cleaner for all mankind.

The role of the Society, the promotion of clean air, has, in essence, remained unchanged for some 78 years. True, the Society should be run on sound financial lines; but equally the Society is a non-profit making organisation whose object is to achieve clean air for all, not only in this country but also abroad. Some countries have not yet made much progress in cleaning the air, while others are only now emerging as industrial nations. We should be prepared to help them by exporting our expertise.

Space will not allow an examination of the Society's many achievements but we believe that history will show that the great efforts, many of which at the time seemed fruitless, made by the Society to create an informed public opinion prepared the way for the clean air legislation which we now enjoy. The work of the Society is on record as being responsible; the Society's suggestions have been well reasoned and reasonable. Because of this the Government now consults the Society and seek its view on future legislation about the control of air pollution.

In 1974 the Society extended its terms of reference to embrace, to some extent, all forms of pollution, a logical progression because the control of one form of pollution can lead to pollution in other forms. Then there was the important realisation that noise constitutes a form of air pollution. This widening of the horizon has affected the Society's role and its future. Nevertheless, the main aim is still the same, the differences are in emphasis.

As the air has become clearer, if not cleaner, and more people are aware of their environment, the media tend to select certain subjects and sometimes to magnify them unduly. Asbestos is one example; lead in petrol is another. The public are confused and do not know what to believe. In this the role of the Society is clear; to put such problems into proper perspective and to inform the public accordingly. Some years ago the effect of air pollution on health was identified with the cardiac and respiratory systems. Now, the effect is perhaps more one of stress—stress caused by worry about the effects of pollutants such as lead and asbestos, to say nothing of noise. The Society's role continues unchanged—to seek to abate pollution and to tell the public the truth.

It is sometimes asked whether there is any need for the Society any more. There is still much work for the Society but its approach to this work must inevitably change to meet changing requirements, although it must not be forgotten that there is still a need for smoke control and that there are still laggard authorities. But above all we must ensure that the rising generation are informed about the problems which exist. They must be encouraged to realise that in the future the solving of such problems will be their responsibility. Here still lies the role of the Society.

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Cover shows a smoke controlled area in Middlesbrough 1976

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Estimates of Smoke and Sulphur Dioxide Pollution from Fuel Combustion in the United Kingdom for 1975 and 1976

by
M-L Weatherley
Warren Spring Laboratory

The estimates are based on fuel consumption statistics published by the Department of Energy. Appendix A explains how the fuel consumption data used in the pollution estimates for 1975 and earlier years were derived from the published statistics. The fuel consumption data for 1976 are provisional and less detailed than the definitive tables; they are taken from the Department of Energy's publication 'Energy Trends' for May 1977.

Estimates of Pollution by Smoke From Coal Combustion

The fuel consumers who have contributed most significantly over the years to overall emission of smoke in the UK are the coal consumers other than the fuel conversion industries. Coal consumption by the latter (power stations, smokeless fuel production plant, etc) is relatively smokeless, as is combustion of petroleum fuels such as fuel oil, and of solid smokeless fuels. The national or overall contribution of smoke from vehicles is also relatively small, though it can have significant local effects. However, it should be noted that as coal consumption outside power stations decreases, and with it the emission of carbonaceous smoke from inefficient coal combustion, the proportion of smoke from other sources becomes progressively larger and is already significant in areas where little or no coal is used for domestic heating.

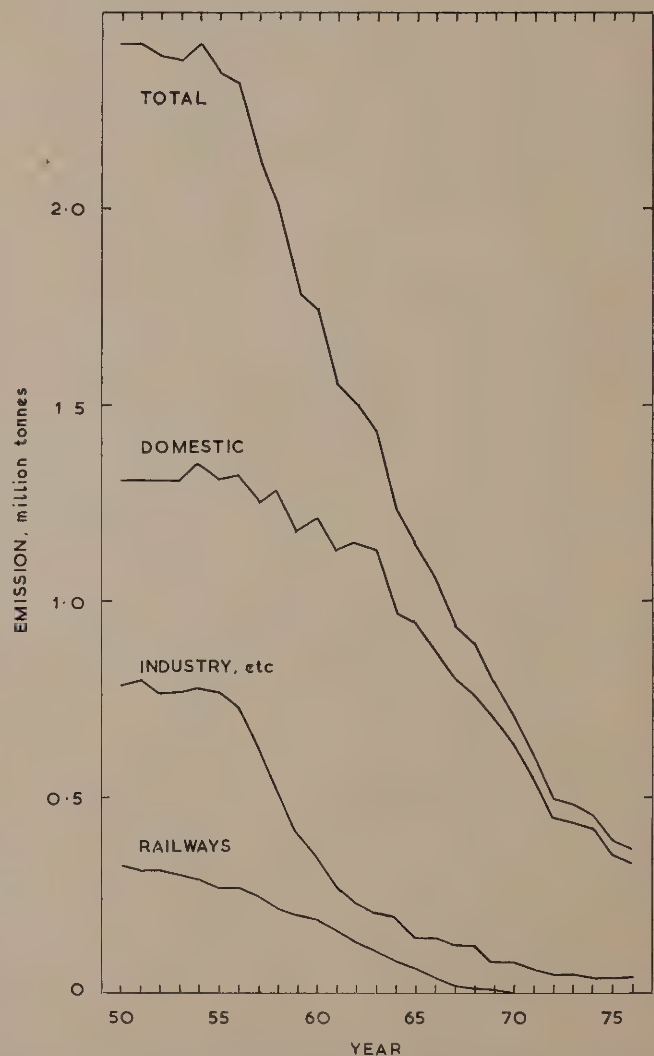


Fig. 1. Emission of smoke from coal combustion in the UK, 1950-1976

Table 1 shows the estimated emission of smoke from coal combustion by domestic and other consumers in 1975 and 1976, and the corresponding coal consumption. It updates the estimates prepared by Dr Albert Parker, CBE, for years up to 1974 in previous issues of Clean Air. The accompanying graph (Fig. 1) shows the trend in emission of smoke from these sources since 1950.

Table 1 Estimates of Pollution by Smoke from Coal Combustion

Class of Consumer	1975 *Coal consumption*	1975 *Smoke emission*	1976p *Coal consumption*	1976p *Smoke emission*
	(*million tonnes*)			
Domestic (²)	10.1	0.35	9.5	0.33
Industry and miscellaneous (²)	12.7	0.04	12.0	0.04
Railway (³)	0.1	0.00	0.1	0.00
Total		**0.39**		**0.37**

p=provisional

(²) Smoke is taken as 3.5 per cent of the weight of coal burnt in domestic open fires, see Brown, R. L., Hawksley, P. G. W. and Horspool, J. M. (J. Inst. Publ. Hlth. Engrs., 1959, *58*, 208).

(²) For years up to and including 1956, smoke is taken as 1.2 per cent of the weight of coal burnt, as in the Report of the Committee on Air Pollution, Comd. 9322, London, HMSO, 1954. For 1962 it is taken as 0.5 per cent, for 1971 and subsequent years 0.3 per cent, with intermediate proportionate values for the intervening years.

(³) No longer a significant smoke emitter. The estimate of 2.0 per cent made in Cmd. 9322 is used.

Estimates of Pollution by Sulphur Dioxide from Fuel Combustion

Table 2 shows the estimated emission of sulphur dioxide from fuel combustion for the years 1975 and 1976; the 1976 figures are provisional estimates. The sulphur contents used in conjunction with fuel consumption data for estimating emissions were provided by the fuel supply industries and are given in Appendix B. The estimates do not include the annual emission from chemical and other processes which probably amounted to a few per cent of the total annual emission from fuel burning.

The sulphur dioxide emissions are given to the nearest 0.01 tonnes, but do not necessarily have this degree of accuracy; in particular the grand total is not accurate to two decimal places.

Because of uncertainties, e.g. in sulphur content of fuels, there are small differences in estimates made by different people for any one year. These between-estimator differences in any one year are of the same order as the changes in total emission estimated from one year to the next by one person. Consistency in estimation over the years is therefore important in any analysis of trends and Fig. 2 shows estimated sulphur dioxide emission since 1969, calculated in the same way as for Table 2.

The breakdown of sulphur dioxide emission by height of emission above ground level in Table 2 and Fig. 2 is the same as that used by the National Society for Clean Air in its booklet 'Sulphur Dioxide'.

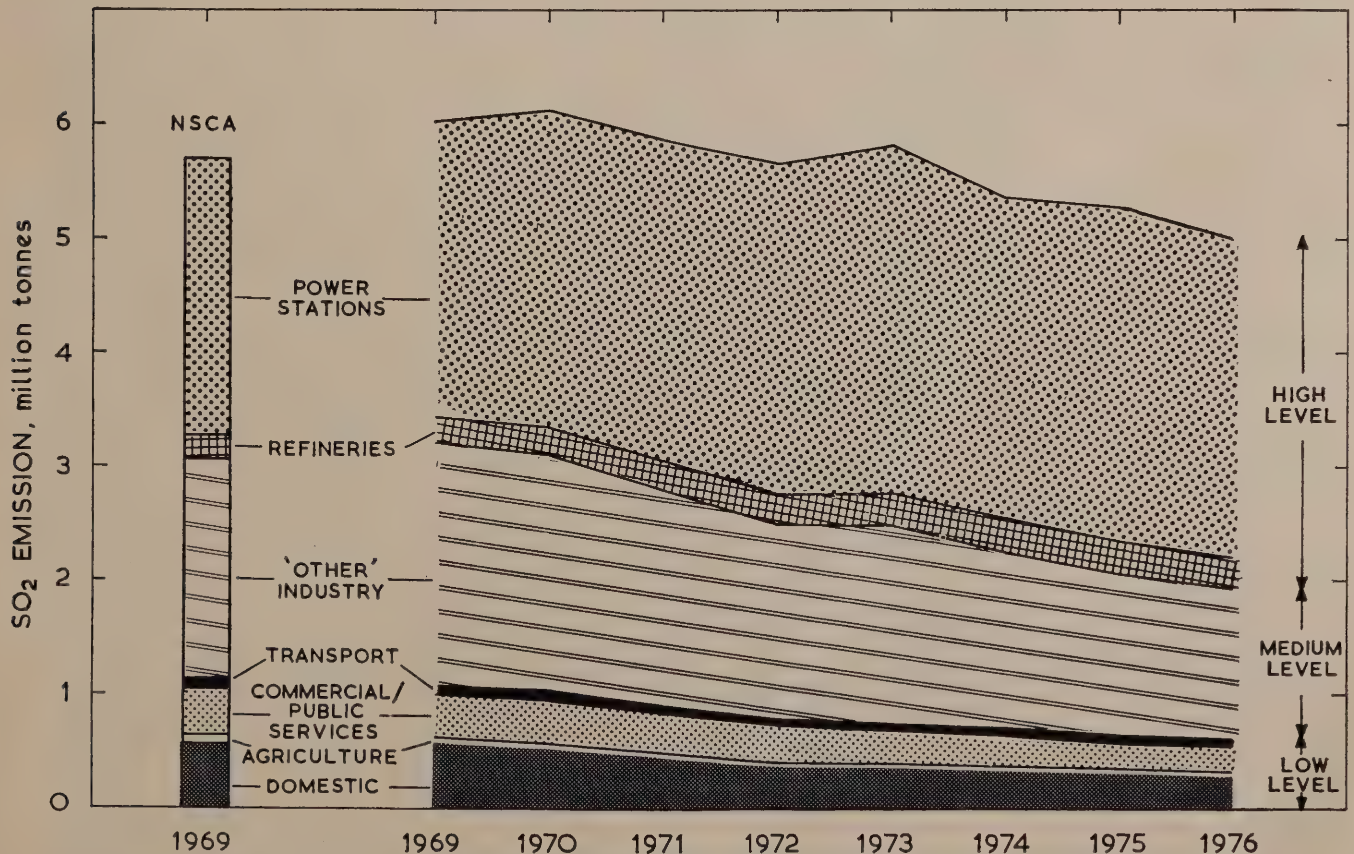


Fig. 2. Sulphur dioxide emissions by type of fuel consumer 1969-76 (NSCA=figures published by the NSCA) 1976 figures are provisional

Table 2. **Estimates of Sulphur Dioxide Emission from Fuel Combustion in the United Kingdom, in 1975 and 1976 (million tonnes unless otherwise specified)**

		1975		1976p	
Class of Consumer	*Fuel Type*	*fuel consumption*	*SO_2 emission*	*fuel consumption*	*SO_2 emission*
High level					
Power stations	coal	74.6	2.15	77.8	2.10
	gas oil	0.4	0.00	0.4	0.00
	fuel oil	12.9	0.80	11.6	0.67
	total		2.96		2.78
Refineries	fuel oil/gas	6.0	0.26	6.3	0.29
Total high level			3.22		3.06
Medium level					
Other industry	coal	14.9	0.27	13.5	0.25
	solid smokeless fuel	2.7	0.05	2.7	0.05
	gas oil	5.0	0.07	5.0	0.07
	fuel oil	15.4	0.90	13.8	0.81
	coke oven gas	987*	0.13	1000*	0.13
Total medium level			1.42		1.30
Low level					
Domestic	coal	10.1	0.20	9.5	0.19
	solid smokeless fuel	5.2	0.08	4.6	0.07
	gas oil	0.8	0.01	0.8	0.01
	fuel oil	0.1	0.00	0.1	0.00
	total		0.30		0.28
Agriculture	gas/diesel oil	1.1	0.02	1.1	0.02
	fuel oil	0.3	0.02	0.3	0.02
	total		0.03		0.03
Commercial/public services	coal	1.8	0.04	2.0	0.04
	solid smokeless fuel	0.8	0.01	0.8	0.02
	gas oil	3.8	0.05	3.8	0.05
	fuel oil	2.2	0.13	1.9	0.11
	total		0.23		0.23
Rail transport	gas oil	0.9	0.01	0.9	0.01
	fuel oil	0.0	0.00	0.0	0.00
	total		0.02		0.02
Road transport	motor spirit	16.1	0.01	16.9	0.01
	diesel fuel	5.4	0.04	5.6	0.04
	total		0.05		0.05
Total low level			0.64		0.61
Grand total†			5.28		4.98
total	coal (including coke oven gas)		2.79		2.72
total	solid smokeless fuel		0.15		0.14
total	petroleum		2.34		2.12
Grand total†			5.28		4.98

p provisional

* million therms

† includes small contributions from combustion of burning oil (kerosine) and other fuels which produce less than 0.01 million tonnes of SO_2 per individual class of consumer.

APPENDIX A SOURCES OF FUEL CONSUMPTION DATA USED IN SMOKE AND SULPHUR DIOXIDE EMISSION ESTIMATIONS FOR YEARS UP TO 1975 INCLUSIVE

Sources are given for the year 1975, tables quoted being those in "Digest of United Kingdom Energy Statistics 1976" Department of Energy (London: HMSO, 1976). The corresponding tables in previous editions are given in the key to table numbers on page 157 of the above.

	Table No.	
Coal		
Domestic—house coal (*a*)	17	Direct final consumption by sectors: House coal.
—miners' coal	17	Direct final consumption by sectors: Miners' coal.
Collieries	17	Consumed by collieries.
Industry (other than fuel producers)	17	Direct final consumption by sectors: Total industry.
Public services (*b*)	17	Direct final consumption by sectors: Public administration.
Miscellaneous (*c*)	17	Direct final consumption by sectors: Miscellaneous.
Railways (*d*)	17	Direct final consumption by sectors: Railways.
Agriculture (*d*)	17	Direct final consumption by sectors: Agriculture.
Power stations	17	Input to secondary fuel producers: Electricity supply industry: Total.
Gas works, low temperature carbonization, patent fuel plants	17	Input to secondary fuel producers: Gas supply industry, Low temperature carbonization plant, Patent fuel plants.
Coke oven gas		
Coke ovens	57	Coke oven gas: Total.
Solid smokeless fuels		
Domestic (*e*)	34	Up till 1972 inclusive, Grand total; from 1973, Grand total, deduct Public services: Coke and breeze (Table 11).
Public services (*f*)	11	Public services: Coke and breeze.
Miscellaneous (*g*)	11	Miscellaneous: Coke and breeze, Other solid fuel.
Industry	11	Iron and steel: Coke and breeze, Other purposes (i.e. 'other' than 'Blast furnaces'); add Other industries: Coke and breeze, Other solid fuel.
Railways (*d*)	11	Transport: Rail: Coke and breeze.
Agriculture (*d*)	11	Agriculture: Coke and breeze.
Petroleum		
Motor spitrit	44	All classes of final consumer: Motor spirit.
Diesel fuel	44	All classes of final consumer: Derv fuel.
Burning oil (*d*)		
domestic—premium	44	Domestic: Burning oil: Premier.
—standard	44	Domestic: Burning oil: Standard.
agriculture	44	Agriculture: Burning oil.
public services	44	Public administration: Burning oil.
industry	44	Other industries: Burning oil.
railways	44	Transport: Railways: Burning oil.
Vaporizing oil (*d*)		
agriculture	44	Agriculture: Vaporizing oil.
Gas oil		
power stations	45	Public utilities: Electricity generation: Gas/diesel oil.
central heating		
private houses/other dwellings	45	Central heating—Non-industrial: Private houses, Other dwellings: Gas/diesel oil.
other non-industrial	45	Total central heating; Gas/diesel oil; deduct Private houses, Other dwellings: Gas/diesel oil.
industry (other than power stations, refineries)	44	All classes of final consumer: Gas/diesel oil; deduct Marine: Total Gas/diesel oil (Table 45); deduct Total central heating (non-industrial): Gas/diesel oil (Table 45); deduct Agriculture and forestry: Total: Gas/diesel oil (Table 45); deduct Railways: Gas/diesel oil (Table 45).
agriculture	45	Agriculture and forestry: Total: Gas/diesel oil.
railways	45	Railways: Gas/diesel oil.
Fuel oil		
power stations	45	Public utilities: Electricity generation: Fuel oil.
central heating		
private houses/other dwellings (*d*)	45	Central heating—Non-industrial: Private houses, Other dwellings: Fuel oil.
other non-industrial	45	Total central heating: Fuel oil; deduct Central heating: Private houses, Other dwellings: Fuel oil.
industry (other than power stations, refineries)	44	All classes of final consumer: Fuel oil; deduct Marine: Total: Fuel oil (Table 45); deduct Total central heating: Fuel oil (Table 45); deduct Agriculture and forestry: Total: Fuel oil (Table 45); deduct Railways: Fuel oil (Table 45).
agriculture	45	Agriculture and Forestry: Total: Fuel oil.
railways (*d*)	45	Railways: Fuel oil.
Refinery fuel	44	Consumption by fuel producers: Refineries.

Notes

Some of the solid fuel statistics for 1973 onwards (e.g. for coal, coke) refer to disposals by fuel producers, whereas those for previous years are for disposals by merchants.

(*a*) mainly domestic, but also commercial and smaller industrial consumers;
(*b*) colliery disposals to national and local authorities;
(*c*) includes disposals from collieries to commercial and non-industrial establishments as well as shipments to the Channel Islands and distribution losses; included with commercial/public services in Table 2;
(*d*) contribution to SO_2 emission very small ($\leqslant$0.005 million tonnes);
(*e*) owing to changes in the form of the energy statistics the tables used are not the same as those used in previous WLS estimations, and give slightly different figures from the earlier estimates;
(*f*) estimates of consumption by national and local authority services;
(*g*) included with commercial/public services in Table 2.

APPENDIX B SULPHUR CONTENTS OF FUELS

Coal	
Domestic	1.3% up to 1971 inclusive, 1.25% from 1972 to 1976; 20% of the sulphur retained in the ash.
Power stations all	1.53% up to 1972, 1.5% in 1973 and 1974, 1.6% in 1975, 1.5% in 1976; 10% retained in the ash; allowance made for gas washing at Battersea.
Gas works etc	SO_2 emission taken as 0.72% of the weight of coal used.
Other users	1.4% up to 1971 inclusive; 1.35% from 1972 to 1974, 1.23% in 1975 and 1976; 10% retained in the ash.
Coke ovens	As unpurified coke oven gas is used by industry, emissions must include these sources as well as the SO_2 emitted by burning the gas to heat the coke ovens themselves. The item 'coke oven gas, total' is used and emissions calculated on the assumption that a million therms of gas contain 65 t sulphur. This then does not include coke oven gas used by gas undertakings and therefore purified.
Solid smokeless fuels	
Domestic	1.0%; 20% retained in the ash.
Other users	1.0%; 10% retained in the ash.
Petroleum	
Motor spirit	0.05% from 1965 to 1973, 0.04% from 1974 to 1976.
Diesel fuel	0.3% from 1965 to 1971, 0.37% in 1972, 0.3% in 1973, 0.37% in 1974, 0.35% in 1975 and 1976.
Burning oil (usually negligible)	Premium 0.05% from 1965 to 1970, 0.06% in 1971, 0.03% from 1972 to 1976; regular 0.10% from 1965 to 1970, 0.08% in 1971, 0.06% in 1972, 0.07% in 1973, 0.05% in 1974, 0.07% in 1975 and 1976.
Gas oil	0.8% in 1965, 0.7% since 1970, (0.69% in 1974); regular decrease assumed between 1965 and 1970.
Fuel oil, power stations	2.8% in 1969, thereafter 2.7, 2.8, 2.95% from 1972 to 1974, and 3.13% in 1975, 2.92% in 1976; allowance for gas washing at Bankside.
Other users	3.1% in 1965, 2.72% from 1970 to 1972, 2.75% in 1973, 2.85% in 1974, 2.93% in 1975 and in 1976; regular decreases assumed between 1965 and 1970.
Refinery fuel	Refinery fuel is a mixture of low-sulphur gas and high-sulphur oil; ¾ of the total consumption is used in estimating sulphur dioxide emission, and sulphur content as for fuel oil, other users, above.

Notes

The sulphur contents of the various fuels in the 1950s were taken from Report of the Committee on Air Pollution, Cmd 9322, London, HMSO, 1954. These were modified for subsequent years in the light of information supplied by the fuel industries, (in particular by the National Coal Board, the Central Electricity Generating Board, and the oil industry, including the Institute of Petroleum), and by the Energy Technology Division of the former Department of Trade and Industry. The Institute of Petroleum publishes the sulphur contents of petroleum fuels, years up to 1975 being given in Petroleum Review, May 1976.

Retrospective analyses of sulphur contents by the fuel industries sometimes involve amendments of the sulphur contents previously supplied for certain years and hence amendments in published estimates of SO_2 emission.

For the provisional estimates of SO_2 emission in 1976, the sulphur contents of petroleum fuels are assumed to be the same as in 1975 (except for fuel oil used in power stations).

For sulphur contents of petroleum fuels in earlier years than those quoted, see Warren Spring Laboratory Report LR 214 (AP) (years 1950 onwards).

CONCENTRATIONS OF SOME AIRBORNE POLLUTANTS AT VARIOUS SITES IN LONDON

Measured and compiled by the Air Pollution Section, Environmental Science Group, Scientific Branch, Greater London Council

The GLC's Air Pollution Section has carried out measurements of smoke and sulphur dioxide at several National Survey sites in London for many years. Measurements of deposited matter have also been made over a long period. More recently, the Section has begun regular measurements (at County Hall) of some other airborne pollutants. A brief monthly summary of the results of some of these measurements has been made since January 1976 and these summaries form the basis of the data presented here.

Since the measurement programme is still developing, there may be changes in the content of the data from time to time.

Table 1 shows the average concentrations of carbon monoxide, oxides of nitrogen and sulphur dioxide at two sites at County Hall, London, during April, May and June 1977.

Table 2 lists some of the data collected during the 12 months ending June 1977.

Table 1

	CO (ppm) 24h average			NO_x (pphm) 24h average			SO_2 ($\mu g/m^3$) 24h average		
	min	mean	max	min	mean	max	min	mean	max
Roof-top site									
April	0·4	1·9	4·0	0·5	2·2	5·2	49	124	235
May	0·4	1·0	1·7	0·5	1·9	4·6	27	97	219
June	0·9	1·5	2·9	0·2	1·4	4·8	30	55(*a*)	111
Road-side site									
April	1·7	3·8	6·4	1·6	10·2(*b*)	16·7	—	—	—
May	1·4	3·0	6·4	3·6	9·0	19·9	—	—	—
June	2·1	3·5	5·4	—	—	—	—	—	—

(*a*) 19 days only
(*b*) 18 days only

Notes

1 The sampling point for the roof-top measurements is about 30m above ground level.
2 The sampling point for the road-side measurements is about 10m horizontally from the edge of a major roadway and about 6m above pavement level.
3 The CO measurements are made with an Ecolyser (Energetics Sciences Inc.).
4 The NO_x measurements are made with a chemiluminescent NO/NO_x gas analyser, model 14D (Thermo Electron Corporation).
5 The SO_2 measurements are made with a Philips SO_2 monitor type PW 9755; they are made only at the roof-top site.

Table 2

	1976						1977						
	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	
Average smoke at 7 national survey sites	20	27	29	32	46	60	45	30	27	24	22	20	apparent $\mu g/m^3$
Average SO_2 at 7 national survey sites	58	64	59	64	106	171	137	85	76	73	68	36	$\mu g/m^3$
SO_2 at County Hall (roof-top)	69	68	—	181	227	285	262	167	149	124	97	55	$\mu g/m^3$
NO_x at County Hall (roof-top)	5·0	3·0	3·5	—	5·2	7·5	7·1	3·0	2·2	2·2	1·9	1·4	pphm
CO at County Hall (roof-top)	—	—	1·7	2·1	1·8	2·9	2·5	2·3	2·2	1·9	1·0	1·5	ppm
NO_x at County Hall (road-side)	—	12	—	13	16	18	15	12	11	10	9	—	pphm
CO at County Hall (road-side)	—	4·0	4·6	4·5	5·4	5·2	3·8	4·3	3·7	3·8	3·0	3·5	ppm
Average deposited insoluble matter at 7 sites	98	89	76	53	52	51	56	65	64	104	91	85	mg/m²d

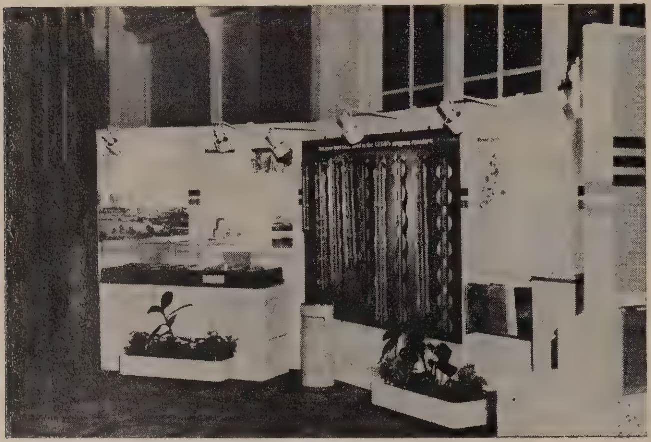
Notes

1 The national survey sites are at Hampstead, Lambeth (2), Hackney, Greenwich, Deptford, and Chelsea. The sites are generally away from busy roads and with the sampling point between 4 and 6m above ground level. Smoke is estimated from the darkness of a filter, and SO_2 from the acidity of a hydrogen peroxide solution, through both of which the air has been sampled.
2 The deposited insoluble matter is determined using British Standard deposit gauges, at ground level. The sites are in various parks and open spaces in London.

The Harrogate Conference

The Clean Air Conference returned to the Royal Hall at Harrogate from 19th-22nd September 1977, after a space of nine years. In order to avoid clashing with other conferences to be held in October, the Conference was held a month earlier this year and this may have been one of the reasons why the number of delegates was not as large as was hoped. Over the last few years numbers attending Conference have been steadily falling and unfortunately this trend was continued at Harrogate where some 270 delegates took part.

The theme of the Conference was ' Why Clean Air? ' We were fortunate in having some good speakers and some excellent papers were presented. As a consequence, the standard of debate was high and the press took more interest than they have in recent years.



The CEGB's Exhibition Stand on Nuclear Power

The Opening Session took place on the evening of Monday, 19th September. Unfortunately Sir Brian Flowers, the new President of the Society, was unable to be present because of a long standing previous engagement. His place in the Chair was taken by the Immediate Past President, Professor Lawther, and the Mayor of Harrogate, Cllr. W. R. Mather, welcomed the delegates and opened the Conference. As the President could not be present, and as Professor Lawther had kindly agreed to present a paper at the first Session on the Tuesday morning, there could be no presidential address as such. In keeping therefore with the Conference theme, Mr T. H. Iddison, MBE, the Chairman of the Council of the Society, presented a short paper entitled ' Clean Air in the United Kingdom—A Brief Survey ' and this was followed by a speech on ' The Society and its Future ' by the Secretary General of the Society.

On Tuesday morning the first proper working session on the need for Clean Air opened with a paper by Professor Lawther on ' The Effects of Air Pollution on Health '. This was followed by a paper on ' The Effects of Air Pollution on Amenity ' by Professor K. Mellanby and undoubtedly these two papers set the stage for the sessions that were to follow. The afternoon session that day surveyed achievements and what remained to be done. Mr E. W. Foskett, the Director of Environmental Health of

Some of the audience in the Royal Hall

the City of Manchester, presented a provocative paper on ' The Future of Smoke Control in the Domestic Field ' and Mr A. I. Biggs of the Confederation of British Industry addressed the Conference on the views of industry with regard to the proposals made by the Royal Commission on Environmental Pollution in their Fifth Report. Mr Biggs had very kindly stepped in at the last moment when Mr C. J. O. Moorhouse, who had originally agreed to present a paper—and indeed his paper was prepared and was included in the Preprints of the Papers to be presented—had to go to Australia on business at the last moment.

On Wednesday morning only one paper was presented in a session which dealt with legislation and control. Mr A. J. Fairclough, the Director of the Central Unit on Environmental Pollution of the Department of the Environment spoke on ' The Environmental Programme of the EEC and its Possible Effects on Existing Clean Air Legislation '. This was a very comprehensive paper which described in detail the workings of the EEC with particular regard to the environment; and although Mr Fairclough expressed the opinion that it would be a long time before the EEC programme had many far reaching effects on the environment and legislation in this country, Professor Scorer and other speakers made it clear that they thought that perhaps things might well develop differently and better.

On the Wednesday afternoon there was a session on the effects of pollution on agriculture and forestry. This consisted of three papers by three experts in their subjects highlighting new research and both the authors and their papers certainly broke new ground. Dr P. L. W. Saunders of the Natural Environment Research Council gave an introduction to the effects of air pollution on plant life; Professor C. P. Whittingham of the Rothamsted Experimental Station presented a paper on ' The Influence of Aerial Pollution on Agricultural Crops ' and Professor F. T. Last of the NERC Institute of Terrestrial Ecology spoke on ' The Effects on Forests and Natural Communities '. This session was open to members of the general public and a number of students and representatives of organisations in the North Yorkshire area joined the delegates.

The final session on the Thursday morning was devoted to nuclear power and the environment. This was, of course, held against the background of the inquiry currently being conducted at Windscale but was in no way intended to enter into the arguments about the pros and cons of nuclear power. It was intended to provide information so that delegates would be in a better position to judge the issue for themselves. Accordingly we were fortunate in having three very good papers, each presented by experts in their own field. Dr R. H. Clarke of the Berkeley Nuclear Laboratories of the CEGB presented a very clear paper on "The Nuclear Fuel Cycle'. This was followed by a paper on 'The Control of Airborne Radioactive Emissions from Nuclear Power Stations in the UK' by Mr J. Beighton, H.M. Deputy Chief Alkali and Clean Air Inspector. Finally, Miss P. M. Bryant presented a paper prepared by herself and Miss F. E. Taylor, both of whom are members of the staff of the National Radiological Protection Board, on 'Exposure of the Public to Radioactive Releases from the Nuclear Fuel Cycle'. This was a long session which might well have gone on longer had time been available. Nevertheless it fulfilled its function admirably in that it did provide essential background information. Indeed the printed papers will, it is thought, prove valuable works of reference.

The authors, and discussion opener Mr R. B. Pepper, during the debate on Nuclear Fuel and the Envirnoment. Prof R. S. Scorer was in the chair

The Conference was of course, one day shorter than hitherto, and for this reason it was necessary for visits and social events to be held concurrently with the Conference sessions. Indeed, technical visits started on the Monday afternoon; but although these visits had been arranged because they had been specially requested, the visits to Messrs John Thurley Ltd at Harrogate and to Messrs George Armitage & Sons Ltd, Mowley Park Brick Works at Dewsbury, were not well attended. On Tuesday morning the ladies enjoyed a special hair and beauty fashion "spectacular" by Mr Brian Leslie of Harrogate, and paid a visit to Harewood House in the afternoon. Other delegates visited the total energy plant at the Leeds General Infirmary and the Kirkstall Road High Density Baling Plant at Leeds. That evening the Chairman, Mr T. H. Iddison entertained the Mayor and Mayoress of Harrogate and representatives of the Harrogate District Council together with members of the Council of the Society and authors and other guests at the Cairn Hotel.

Mr. T. H. Turner, Miss M. George, Mr. K. R. Enderby, Dr. P. J. W. Saunder and the Chairman, Mr T. H. Iddison, at the Chairman's reception

On the Wednesday morning a visit to the Harlow Car Gardens at Harrogate was, in spite of the very heavy rain, a very popular feature, and many delegates also took the opportunity to visit York that afternoon. There were also technical visits to Universal Machinery and Services Ltd at Leeds and the Hargreaves Clearwaste Services at Wakefield.

On the Wednesday evening the Mayor and Corporation of Harrogate very kindly entertained the delegates to a Civic Reception, Dance and Cabaret at the Royal Hall. This was a very enjoyable occasion and it was unfortunate that there were not more delegates at Harrogate to enjoy the lavish hospitality provided.

Although the Conference finished officially at lunch time on Thursday 22nd September, the golfers were not to be outdone in competing for the Solid Smokeless Fuels Federation Cup. 17 competitors took part in the competition which was played on the Pannal Golf Course on the Thursday afternoon. The Cup was won by Mr Brian Blaikie from Northern Ireland. Playing off a handicap of 2 on a very long course he returned 35 points and is to be congratulated on an excellent score. The day started off wet and windy but fortunately cleared up to give the competitors a pleasant and most enjoyable afternoon, at the end of which the prizes were presented by Mrs M. Richards — who also took part in the competition — to Mr Blaikie and Mr Davison who was second, and Cllr C. Brett who was third.

For those who attended the Conference was a very busy time indeed. A lot was crowded into 3½ days and it served to show that the short Conference which does not take delegates away from their work and homes for so long a period can comprise a programme which is worthwhile and enjoyable.

POLLUTION ABSTRACTS

Papers presented to the 44th Clean Air Conference, Harrogate, 19-22 September 1977

69 'The Effects of Air Pollution on Health'. Professor P. J. Lawther, Medical Research Council.

Problems concerning the possible effects of air pollution on health have altered radically in the last twenty five years, and new approaches must be tried in their investigation. There was little difficulty in demonstrating the effects of coal smoke and its attendant sulphur compounds on morbidity and mortality, even though the specific pollutant responsible remains unidentified. The implementation of the Clean Air Acts and the application of common sense have produced a dramatic improvement in air quality, so much so that it is now very difficult to demonstrate any effects of air pollution on health. This does not mean that there are no effects, but that the "signal to noise ratio" is so low that effects are submerged. Even if there were no humanitarian reasons for continuing research into these effects, there would still be an urgent need for work to test the validity of the grounds for standards-setting. This paper is concerned with the special needs for caution in applying the results of current research, and with the difficulties in designing future work so that it may be used to justify action which might be very costly indeed.

70 'The Effects of Air Pollution on Amenity'. Professor K. Mellanby, Monkswood Experimental Station.

The author proposes that if the air is foul, amenity is destroyed, for the environment is then neither pleasant nor agreeable. Some of the ways in which this is done are examined. The review covers air pollutants from stationary and mobile sources, and describes the reactions of various organisms to the state of the atmosphere, with particular reference to recent studies on the effects of SO_2 emissions.

71 'What Has Been Achieved And What Remains To Be Done In The Domestic Field.' E. W. Foskett, Director of Environmental Health, City of Manchester.

Achievements in the control of air pollution are reviewed in the light of the original aims of the Beaver Committee's recommendations. The twenty two years since that time have produced changes in the economy which could not have been anticipated by the Committee. The author points out that, although difficult to estimate precisely, substantial improvements in air quality and consequently in amenity, have been made, particularly in the industrial, formerly "black" areas.

However, legislation that relies heavily on the will of local authorities to produce these beneficial results, is now less effective when restrained by ambiguous central government directives urging economies in environmental health expenditure. The author puts forward a strongly argued case for whole hearted and speedy completion of existing smoke control programmes, and the implementation of new programmes as necessary.

72 'What Has Been Achieved and What Remains to be Done in Industry". C. J. O. Moorhouse, Environmental Affairs Adviser, The Rio Tinto-Zinc Co. Ltd.

Growing pressure from the public and government has forced industry to take the need for pollution control and environmental protection seriously. Many corporations now employ pollution control specialists. Environmental control costs now form a substantial proportion of capital, maintenance and operating expenditures. Industry's achievements include a substantial contribution to the reduction of smoke under the Health and Safety at Work Act 1974. The philosophy and practice of these controls, exercised on some 2,000 works in the UK, is explained. The author discusses in detail the problems with which he is familiar, notably those of the aluminium industry. The special problems posed by motor vehicles are also described. Future control on industry will have to take account increasingly of international obligations and commitments. Reference is made to concern over and research into specific pollutants, and to EEC policies as they are likely to affect the UK. Industry is able to make a substantial contribution to this research in order to secure an acceptable environment for the future.

73 'The Fifth Report of the Royal Commission on Environmental Pollution—Comments by the C.B.I.' A. I. Biggs, C.B.I.

The paper discusses the reactions of industry, as represented by the C.B.I., to the findings and recommendations of the Fifth Report of the Royal Commission on Environmental Pollution. Should the recommendations finally be accepted by the government, and implemented as they stand, industry would face changes in pollution control authorities and in planning consent conditions, amongst others. With some reservations, the C.B.I. accepts the main recommendations in the Report. It would like to see the Alkali Inspectorate returned to the Department of the Environment forthwith, irrespective of whether or not the new central pollution inspectorate is established. The C.B.I. also believes that should such an inspectorate be established, it should be small, but technically highly competent, and have advisory, but not executive functions.

74 'The Environmental Programme of the EEC and its possible effects on existing Clean Air Legislation'. A. J. Fairclough, Director, Central Unit on Environmental Pollution, DoE.

The author establishes the connection between the Common Market and the quality of air in Britain by explaining how the EEC's decision-making processes operate and take effect in member states, and what the UK's broad policy has been in relation to environmental matters. The Community has adopted a wide-ranging Environmental Action Programme, divided into two broad areas —measures to reduce pollution and nuisances; and action to improve the environment. This programme is examined in detail: its whole approach is based on the establishment of appropriate environmental quality objectives, developed in the light of scientific criteria; and that legally binding standards of various kinds are seen as possible means whereby these objectives can be approached. The process by which scientific criteria are established, and the UK's own (pragmatic) approach, are discussed. Progress in the implementation of the EEC programme as it relates to air pollution is detailed. In terms of immediate impact on UK policies, practices and legislation, it does not appear that the Community's environment programme will move very far or fast, but it is hoped that the UK's contribution to detailed discussions of EEC proposals will enable a pragmatic compromise to be reached.

75 'Air Pollution and Plant Life—An Introduction'. Dr P. L. W. Saunders, Natural Environment Research Council.

Air pollution is recognised as a hazard to man. It also has many other environmental consequences including adverse effects on plants and soils. Experiments have demonstrated effects on plants which are of potentially great significance in agriculture, forestry and the natural environment. Confirmation of such effects in the field, however, is difficult to obtain. This is because the response of a plant is the product of complex interactions between plant, pollutant and environment. The paper reviews the occurrence and mechanisms of the uptake of various air pollutants by varieties of plant life. Wider alterations to the environment, which may be derived from laboratory and field observations of air pollution damage to plant life, are indicated.

76 'The Influence of Aerial Pollution on Agricultural Crops'. Professor C. P. Whittingham, Rothamsted Experimental Station.

The paper is concerned with the evaluation of the effects of certain pollutants, dispersed through air, which are suspected of having a widespread influence on agricultural production in a considerable part of the acreage of the UK. Significant effects established as resulting from a long-term exposure to a relatively low level of pollutant are economically more important than acute local effects because of the large acreage involved. Four main groups of aerial pollutants which influence plant growth are classified, and their known effects at relatively high concentrations characterised. It is much more difficult to readily distinguish damage from long-term, low-level exposure. Examples are given of the variation in different crops' susceptibility to pollution. Much discussion concerning the economic loss to agriculture resulting from air pollution has been based on studies in experimental fumigation chambers. However, Rothamsted are developing the use of experimental field procedures to evaluate loss due to air pollution with one particular cereal crop, barley. These investigations to date are described in detail.

77 'Effects on Forests and Natural Plant Assemblages'. Professor F. T. Last, NERC, Institute of Terrestrial Ecology.

The paper concentrates on two aspects of the subject—(1) the ways in which natural populations of plants respond when exposed to one of a variety of pollutants, and (2) the recent changes in our approach to the sulphur problem, particularly as applied to forests. Relevant research on damage to predominantly rural woodlands and forests is reviewed. The author concludes that there is no good evidence to suggest that sulphur pollutants are deleteriously affecting the incremental growth of trees in rural areas. But the long-term effects of wet and dry deposition from incoming sulphur in the UK and southern Norway cannot yet be assessed, and complacency would be inexcusable. In discussing population changes among natural communities of plants, possibly attributable to air pollution, the author uses examples recorded in the UK. Reference is also made to the interdependence of plants and animals, since pollutants, by affecting lichens, may also affect some invertebrates.

78 'Radioactivity and the Nuclear Fuel Cycle'. Dr R. H. Clarke, Berkeley Nuclear Laboratories, CEGB.

This paper begins by outlining the main features of radioactivity and the natural radioactivity in the environment to which man is subjected. Against this background, the principles of nuclear power are explained and the differences between the various types of reactor in operation today described. The nuclear fuel cycle is then followed and the radioactive discharges which occur at each stage of the cycle, mining, fuel fabrication, reactor operation and fuel reprocessing, are identified.

79 'The Control of Airborne Radioactive Emissions from Nuclear Power Stations in the UK'. J. Beighton, HM Deputy Chief Alkali and Clean Air Inspector.

A general review is given concerning normal operational discharges to air and related to the public environment. Information is provided on authorities and legislation involved and of principles and practice of control.

80 'Exposure of the Public to Radioactive Discharges from the Nuclear Fuel Cycle'. Pamela M. Bryant and Frances E. Taylor, National Radiological Protection Board.

The effect on the environment, on the public and on society itself, of present and proposed operations of the nuclear fuel cycle is now the subject of substantial public debate. This year is notable for the public inquiry into the proposed oxide reprocessing plant at Windscale. This paper summarises the means used to assess the radiation exposure of the public arising from the discharge of radioactive effluents. Doses incurred by the population can be assessed either by an adequate knowledge of the quantities discharged and of the transfer parameters involved, or by means of a programme of environmental monitoring that is usually related to pathways selected as being of the greatest importance. The author draws attention to the limitations of both methods of dose assessment. The levels of radiation exposure resulting from the operation of thermal reactor fuel cycle installations in the UK in recent years are reviewed and the relevant primary radiological protection standards quoted. The paper concludes with a brief summary of a recent assessment of the radiological protection standards quoted. The paper concludes with a brief summary of a recent assessment of the radiological significance from long-lived radionuclides discharged from nuclear installations.

New Smoke Control Orders

The lists below are supplementary to the information in the last issue of **Clean Air (Autumn 1977)** *which gave the position up to* **30 June 1977.** *They now show changes and additions up to* **30 September 1977.**

Some of the areas listed are new housing estates, or areas to be developed for housing. The total number of premises involved will therefore increase. An asterisk denotes that there have been objections and that a formal inquiry has been or will be held.

The list of new areas in operation of smoke control is based on the plans submitted to the Department of Environment, but may erroneously include some local authorities who have made postponements, without notifying the Ministry of the fact.

ENGLAND

NEW SMOKE CONTROL ORDERS IN OPERATION

Northern
Allerdale No. 4 (Bolton Street, Workington) and No. 5 (Salterbeck Road/Workington); Hartlepool No. 31; Middlesbrough No. 20 (Whinney Banks) and No. 22 (Acklam Road/ Ayresome, Green Lane); Stockton-on-Tees No. 6 (Cowpen Bewley Village) and No. 7 (Roseworth North).

North Western
Burnley No. 1; Chorley No. 2 (Clayton Brook); Liverpool Nos. 27 and 28; Tameside (Dukinfield No. 19).

Yorkshire and Humberside
Calderdale No. 22 (Halifax Boothtown) and No. 4 (Hebden Royd-Cragg Vale); Scunthorpe No. 11; Wakefield (Hemsworth No. 1) and (Pontefract No. 10).

West Midlands
Birmingham Nos. 163 and 532; Dudley No. 135 (Hawne); East Staffordshire No. 6; Rugby Nos. 19 and 20; Walsall No. 25 (Shelfield); Warwick Nos. 5 and 6; Wolverhampton (Finchfield Area) No. 21; Wrekin No. 2.

East Midlands
Ashfield Nos. 3 and 4; Bassetlaw (Worksop Area No. 5 Valley Road).

South West
Cheltenham No. 8 (Charlton Park) and No. 9 (The Running Track); Exeter (St. James No. 1).

South East
Bracknell No. 6 (Central); Portsmouth No. 3; Southampton No. 17 (Nicholstown); Stevenage No. 4.

London Boroughs
Merton No. 33; Waltham Forest Nos. 29 and 30.

NEW SMOKE CONTROL ORDERS CONFIRMED BUT NOT YET IN OPERATION

Northern
Derwentside (Burnopfield No. 2) and (Anfield Plain No. 2); Hartlepool No. 32; Newcastle No. 3 (Castle Ward).

North Western
South Ribble Nos. 4 and 5; West Lancs No. WL3; Warrington No. 4 (Lymm).

Yorkshire and Humberside
City of York No. 6.

West Midlands
Dudley No. 137 (Oldswinford); Wyre Forest No. 1.

East Midlands
Bassetlaw (Worksop, Area No. 7A, Kilton Forest); City of Lincoln No. 14; Mansfield D.C. No. 4.

South East
Watford Nos. 16 (Knutsford) and 17 (Bradshaw).

London Boroughs
Bromley No. 29; Hillingdon No. 32.

NEW SMOKE CONTROL ORDERS SUBMITTED BUT NOT YET CONFIRMED

Northern
Derwentside (White-le-head No. 1); Middlesbrough No. 31 (Borough Road/Lindthorpe Road); North Tyneside Nos. 2, 3, 4, 5 and 6; Stockton-on-Tees Nos. 9 (Junction Road, Norton), 10 (Arncliffe Estate), 11 (Preston), 12 (Eaglescliffe).

North Western
Blackburn No. 18; Bolton No. 8 (Horwich Nos. 8 and 9); Oldham Nos. 24 (Austerlands/High Moor), 25 (Fitton Street/Crompton), 26 (Whitefield Hall/Crompton); Rossendale No. 2; Tameside (Ashton No. 18) and (Ashton No. 19); Warrington No. 4 (Lymm).

Yorkshire and Humberside
Barnsley No. 13; Doncaster (Mexborough) Nos. 7, 8 and 9; Harrogate No. 8 (Town Centre); Leeds Nos. 5 (Kortley Middleton Road), 6 (Rothwell Mickleton) and 7 (Rothwell Stourton); Scunthorpe No. 12.

West Midlands
Birmingham No. 533; Coventry No. 18; Rugby No. 22.

East Midlands
Ashfield D.C. No. 6; Blaby No. 11 (Kirby Muxloe).

South West
Bath City No. 1.

South East
Portsmouth No. 4; Southampton No. 18 (Northam and Chapel).

NORTHERN IRELAND

NEW SMOKE CONTROL ORDERS IN OPERATION

Antrim B.C. No. 5.

NEW SMOKE CONTROL ORDER SUBMITTED BUT NOT YET CONFIRMED

Newtownabbey B.C. No. 9.

SCOTLAND

NEW SMOKE CONTROL ORDER IN OPERATION

Monkland District
Airdrie No. 3.

SMOKE CONTROL AREAS

Progress Report

Position at 30th September 1977

(Figures supplied by the Department of the Environment, The Welsh Office, the Department of the Environment for Northern Ireland and the Scottish Development Department).

	England			Wales			Scotland			Northern Ireland		
Smoke Control Orders Confirmed prior to 30.6.77	4,814			24			256			75		
Acres		1,612,479			2,962			138,044			18,393	
Premises			6,987,127			10,754			578,681			52,220
Smoke Control Orders Confirmed (30.6.77-30.9.77)	18			—			1			—		
Acres		18,085			—			584			—	
Premises			26,082			—			2,104			—
Totals	**4,832**	**1,630,564**	**7,013,209**	**24**	**2,962**	**10,754**	**257**	**138,628**	**580,785**	**75**	**18,393**	**52,220**
Smoke Control Orders Submitted (30.6.77-30.9.79)	37			—			—			1		
Acres		18,770			—			—			172	
Premises			41,841			—			—			1,293
Grand Totals	**4,869**	**1,649,334**	**7,055,050**	**24**	**2,962**	**10,754**	**257**	**138,628**	**580,785**	**76**	**18,565**	**53,513**
Smokeless Zones (Local Acts) in Operation ..	44			—			—			—		
Acres		3,400			—			—			—	
Premises			41,060			—			—			—

A Study of Atmospheric Pollution by Trace Elements in the Swansea Area

by

N. J Pattenden

Environmental and Medical Sciences Division, Atomic Energy Research Establishment, Harwell

INTRODUCTION

In 1972, a collaborative study of atmospheric pollution by heavy metals in the Swansea area was started. The study, which was commissioned by the Welsh Office, lasted a year and consisted of a detailed examination of element concentrations in samples of airborne particulate, material deposited both dry and in rain, material deposited on moss bags, some agricultural and veterinary products, and human blood. All the results and conclusions are given in a report produced by the Welsh Office[1]. The present paper describes some of the measurements of airborne particulates, carried out as part of the above study, since such measurements are rather similar to the various multi-element surveys now being undertaken for a number of local authorities throughout the country.

These measurements were part of the responsibilities[2] of the Atomic Energy Research Establishment, Harwell, in the study.

The Swansea area study was undertaken as a consequence of: (a) Concern with the problems of environmental pollution in an area with a long history of non-ferrous and ferrous industry. (b) Reports of horse deaths said to be associated with lead poisoning. (c) The measurements by Goodman and Roberts[3], of elevated levels of certain metals in soils, mosses, etc.

Thus, the study of lead pollution was a major consideration at the planning stage. However, the study was conceived to be much wider than a lead investigation, which in the event proved to be a farsighted policy. The Welsh Office specified that samples should be analysed for vanadium, chromium, cobalt, nickel, copper, zinc, arsenic, selenium, cadmium, mercury and lead. Since the air particulate samples were analysed by a multi-element technique (instrumental neutron activation), in fact results for many more elements were also obtained and reported.

SAMPLING AND ANALYSIS

The sampling requirement was to obtain for trace element analysis samples of atmospheric particulate material. The samples had to be as far as possible representative of particular regions of the study area over a period of one year. In addition, it was hoped that information could be derived about the sources of some trace metals by attempting to correlate their observed concentrations with wind direction. Consequently, continuous sampling was carried out from June 1972 to May 1973 at a number of sites, changing samples at weekly intervals.

Site selection

As far as possible, the following site requirements were satisfied, but it was inevitable that some compromises had to be made: (a) it should have access to electricity, to operate the air pump, (b) it should be reasonably secure or secluded, to minimise the chance of unauthorised tampering, (c) it should be reasonably close to residential areas and/or crops, to allow a meaningful link between the atmospheric and the other measurements, (d) it should be in the vicinity of possible local pollution sources, but in such a way as to be representative of the human residential environment, (e) it should not be immediately adjacent to a busy main road.

Two sampling stations were located in relatively unpolluted areas west of Swansea, to assist in establishing a baseline for the measurements; these were the Kidwelly and Penmaen sites. Also, it was decided that one station should be effectively "mobile"; this was at Baglan for the first 6 months and at Mount Pleasant for the second 6 months. The other 4 stations were located at Clydach, Llansamlet, Port Talbot and Skewen. In addition, a further station at Trebanos, which was part of a project sponsored by the Natural Environment Research Council, fitted well into the present study and results from it are included here with the permission of the NERC.

The site locations are shown on the map in Figure 1.

Sampling techniques

A general description and assessment of the sampling techniques has been given by Cawse and Peirson[4]. Airborne particulate matter was collected by drawing air upwards, at about 6 l/min, through a Whatman 40 paper filter. The filter was held in a specially-designed plastic holder, which minimises trace element contamination and allows continuous collection without clogging for at least a month. It has been shown[5] that this technique allows the collection of outside air samples with a rather similar particle size range to that which is inhaled into the pulmonary region of the lungs.

It should be remembered that this type of sampling method only collects non-volatile particulate material and will not truly represent such materials as elemental mercury and volatile compounds.

In addition to the total particulate sampling, described above, some differential particle size sampling was also performed. This was done at the Trebanos station over

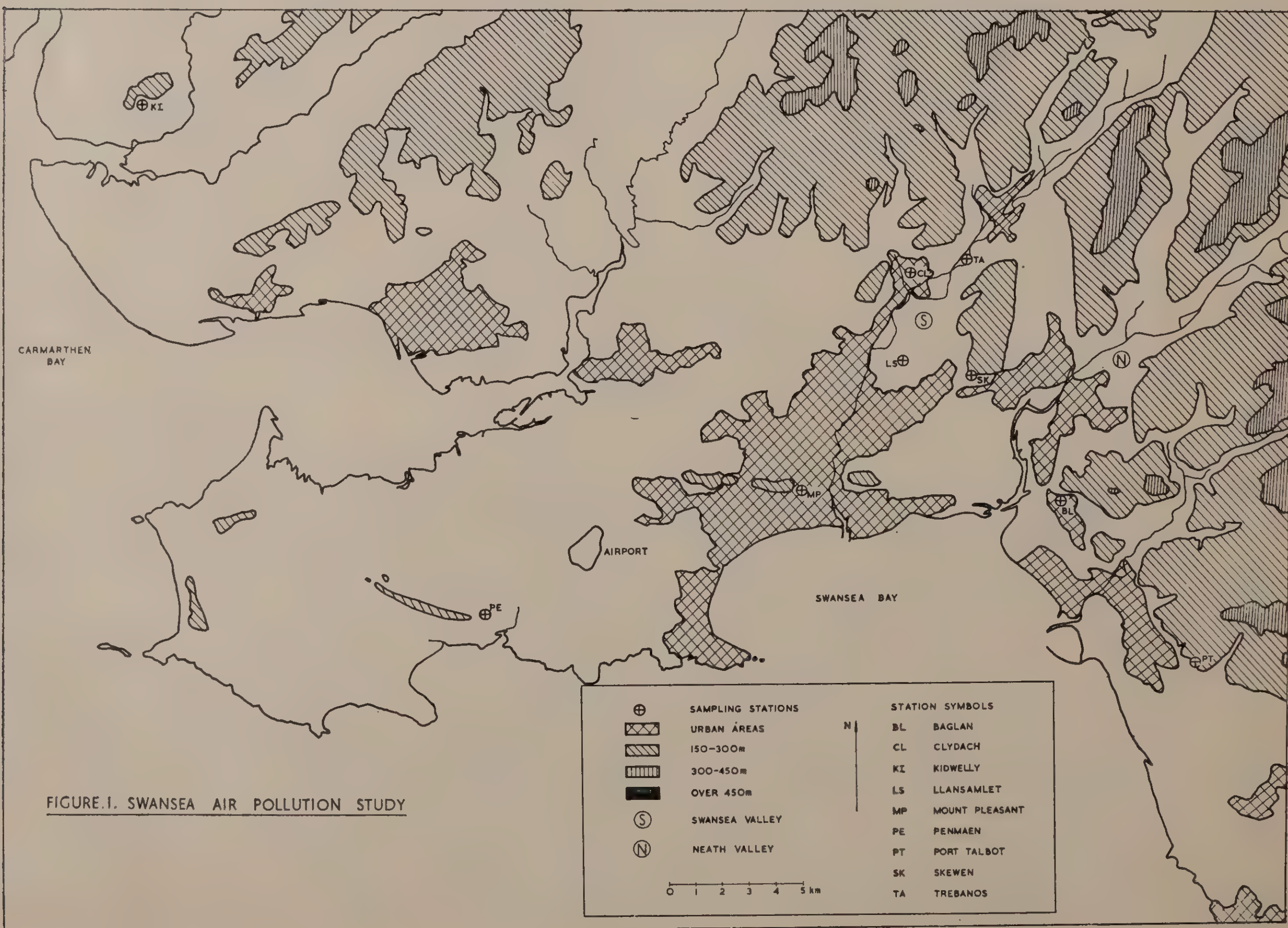


FIGURE.1. SWANSEA AIR POLLUTION STUDY

a period of about four months, using an Andersen model 20-000 8-stage cascade impactor, which sorts the particles into eight different size ranges between 0·4 and 10 micrometers (μm) diameter. Polythene sheet material was used for sample collection on each stage of the cascade impactor, which could be analysed by methods similar to those used for the rest of the samples.

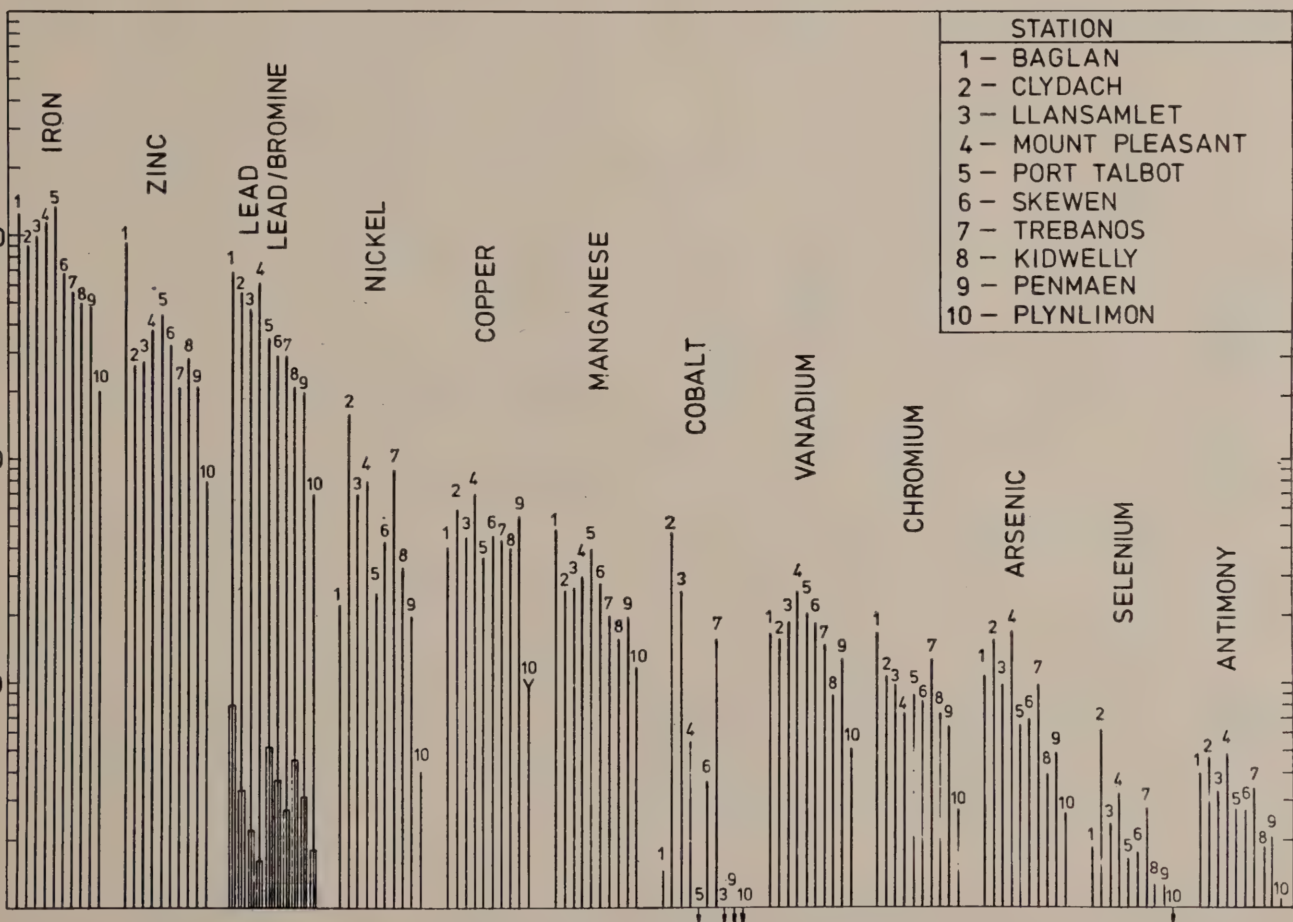
Analytical methods

Instrumental neutron activation analysis[6] was employed for vanadium, chromium, cobalt, copper, zinc, arsenic, selenium, cadmium and mercury, and X-ray fluorescence for nickel and lead. In addition to these elements which were specified by the Welsh Office, the neutron activation analysis gave values or limits for the following elements: sodium, aluminium, chlorine, scandium, manganese, iron, bromine, indium, antimony, caesium, cerium, thorium.

RESULTS

Details of the results are given in the Welsh Office report[7], but a summary of the concentrations of some elements in air particulate material averaged over the whole year studied is shown in figure 2 for each station, together with the lead-to-bromine ratios. For comparison purposes, figure 2 also shows similar results measured at Plynlimon, a remote rural station in mid-Wales. In the cases of the Baglan and Mount Pleasant stations, the results apply to the first and last 6-monthly periods of the year.

Figure 2 does not include results for cadmium and mercury, since these were generally below the detection limits of about 100 and 0·5 ng/m³ respectively.



CONCENTRATIONS IN AIR PARTICULATE (ng/m³): SWANSEA AREA 1972-73

DISCUSSION OF RESULTS

Concentrations in air particulate

An examination of figure 2 reveals a number of features of the results:

(i) Although the 'local' control stations Kidwelly and Penmaen have lower values than the Swansea area stations, they are still much higher than the remote Plynlimon station, suggesting that they are significantly influenced by the Swansea industrial complex.

(ii) Certain element concentrations at some stations stand out from the rest, indicating the presence of nearby sources. These are cobalt at Clydbach, Llansamlet and Trebanos, nickel at Clydach, Trebanos, Mount Pleasant and Llansamlet, selenium at Clydach and zinc at Baglan. Presumably, the high nickel levels are due to emissions from the nickel works at Clydach. The cobalt levels, which are even higher at Clydach relative to other stations, are also presumably due to the nickel works which is understood to produce cobalt as a by-product. The source of the high zinc level at Baglan is less easy to identify, but there is understood to be a nearby open-hearth steel works using scrap steel (largely car bodies) as input material and emissions from this might be responsible.

(iii) The lead concentrations throughout are normal for such an area, the only unusual feature being the high lead/bromine ratio of 7·9 at Baglan (shown in figure 2). The "normal" situation is for atmospheric lead to be due mainly to motor vehicle exhaust, with a lead/bromine ratio of

2·5-3. Thus the high ratio at Baglan indicates a significant non-vehicular source of lead, which may also be the scrap steel works.

Possible human hazards

No official standards for outside air quality exist in Britain. An unofficial rough guideline is the threshold limit value for factory air (TLV) divided by 40. However, it must be emphasised that TLV's are not intended for use in this way and are only mentioned because no better alternative exists.

Table 1 lists the highest weekly concentrations of some elements which were observed during the study, together with the highest annual average values. It also shows the guideline TLV's divided by 40 for these elements and gives ratios of the annual averages to the guidelines. It is clear that the observed concentrations do not present any significant short-term health hazard to the great majority of the public from inhalation of these elements in the airborne dust. Lead is the element which has the highest ratio of 18 per cent; other elements with ratios of more than 1 per cent include nickel, iron, zinc, cobalt, copper and arsenic. The effects of the other elements measured would seem to be negligible.

Swansea area survey 1972-73
Element concentrations in air particulate
(nanogram/cubic metre)

Element	Highest weekly measurement	Highest annual average	(1) TLV÷40	(1) Ann. avg. / TLV÷40
Vanadium	80	26	12500	0·002
Chromium	90	17·4	12500	0·0014
Manganese	110	48	125000	0·0004
Iron	5000	1350	25000	0·05
Cobalt	300	48	2500	0·02
Nickel	600	160	2500	0·06
Copper	300	70	5000	0·014
Zinc	4000	920	25000	0·04
Arsenic	50	17·5	1250	0·014
Selenium	30	6·3	5000	0·0013
Antimony	40	4·7	1250	0·004
Lead	2600	680	3800	0·18

(1) TLV is Threshold Limit Value for factory air, refer to 40 hour work week

Table I. Highest weekly & annual average element concentrations in air particulate, compared to threshold limit values divided by 40.

Unfortunately, very little is known about the long-term effects of relatively low concentrations of many elements, either separately or combined with each other. It may be that mainly by studies of this type, carried out in different parts of the country and compared with statistics on the incidence of disease, can such knowledge be acquired.

An annual average lead concentration of 680 ng/m^3 is not uncommon for cities. Nevertheless, its inhalation is bound to increase the lead levels in the blood of residents. There is experimental evidence[7] to indicate that long term exposure of adults to 1000 ng/m^3 of lead contributes at least 1 microgram lead per 100 millilitre blood (μg/100 ml). The average levels are considered to be about 23 μg/100 ml, and the same limit about 40 μg/100ml[8], although there are different opinions on the latter, particularly concerning children. These values illustrate the small factor of safety which exists between the average levels and the level which, if exceeded, might be injurious to health. They underline the importance of keeping the exposure to lead of the human population to a minimum.

In the case of residential areas, it is not simply the inhalation hazard which must be considered, but also the fact that airborne dust eventually settles on the ground and exposed surfaces, including, for example, vegetables growing in allotments and food displayed in street markets. These are possible pathways for human intake of pollutants. Another is the ingestion of dust by children at play in streets and playgrounds. Such considerations must be included when estimating hazards and setting air quality guidelines.

Particle size effects

The Task Group on Lung Dynamics, of the International Commission on Radiological Protection, reported on the deposition of airborne particles in the human respiratory tract[9]. Their conclusions were that for particles of greater than 2 micrometers diameter, deposition in the nasopharynx compartment is predominant, whereas for particles of less than 2 micrometers diameter, deposition in the pulmonary compartment becomes progressively more important. It is the latter which provides the more significant dose.

The results of the particle size measurements at the Trebanos station showed that different trace elements were associated with different particle size distributions. The elements vanadium, nickel, zinc, arsenic, selenium, antimony, caesium and lead all occurred more than 50 per cent by weight in the less than 2 micrometer range. The elements cobalt, sodium, scandium, iron and cerium were more than 50 per cent by weight in the greater than 2 micrometer range. The elements chromium, copper and manganese were fairly equally distributed over the two ranges.

The elements which are predominantly associated with larger particles are not likely to be as great an inhalation hazard as the others. However, their deposition rate to the ground is likely to be greater and hence their uptake by food may be more significant.

Wind-directional effects

No direction-sensitive sampling was performed in this study. However, an attempt was made to look for wind-directional effects by examining the hourly records of average wind speed and direction. taken at the meteorological office station at Rhoose (48 km southeast of Swansea). A computer study of these showed whether individual weeks of the study period could be characterised by a particular wind direction; in fact, 36 weeks were characterised. The weeks were grouped according to their wind direction and average air particulate concentrations were obtained for each direction at each station.

The inherent problems in this approach should be emphasised. The distance of Rhoose from Swansea means that no accurate directional significance can be obtained from the results, but only trends. Furthermore, winds between south and west will tend to blow up the Swansea and Neath valleys and winds between north and east will tend to blow down the valleys. Also, a week is too long a period in which to ensure that the wind blows solely from a particular direction.

Some of the results are shown diagrammatically in figure 3. For the four stations around the Clydach nickel works, the relative concentration in air particulate for different wind directions are shown for cobalt, nickel and sodium. The case of nickel is clear; for all stations, the concentration increased when the wind came from the works. The situation with cobalt is not so easily ex-

plained. Llansamlet and Skewen show it coming from the works direction, but Clydach and Trebanos indicate a source to the northwest of the study area. For sodium,

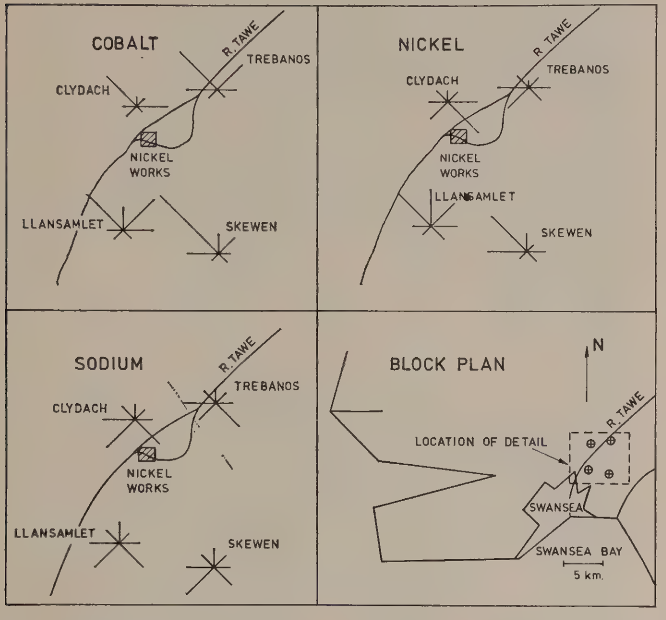


Fig. 3. Relative element concentrations for different wind directions, measured at four stations. Swansea Area Survey 1972-73

all stations indicate a source to the southwest, which is undoubtedly sea spray.

CONCLUSIONS

The results of the year's study allowed the following conclusions to be drawn: (i) The concentrations of the elements measured in airborne particulate did not constitute a known inhalation hazard to human health. (ii) Concentrations of airborne lead were normal for the area (a smelter suspected of having caused lead pollution in the past closed down shortly before the study commenced). (iii) Concentrations of airborne cobalt and nickel were high with strong evidence (at least for nickel) for the source being emissions from the local nickel works. (iv) Concentrations of airborne zinc were rather high at Baglan, indicating a nearby source, which may also have been a lead emitter.

ACKNOWLEDGEMENTS

My colleagues at A.E.R.E., Harwell, P. A. Cawse, R. S. Cambray, Miss E. M. R. Fisher, D. H. Peirson, L. Salmon, J. Watling, K. Playford, Miss C. Paice, and Mrs I. Lovegrove contributed materially to the success of this study.

The work of the station operators must also be acknowledged. They performed the vital functions of taking weekly and monthly readings, changing and sending samples, and performing various maintenance operations. They were Messrs Heycock, Morgan and Rattenbury, Port Talbot Borough Council (Baglan and Port Talbot), Mr I. Lewis, Pontardawe Rural District Council (Clydach and Trebanos), Mr G. Griffiths, Neath Rural District Council (Skewen), Messrs E. Thomas and A. S. John, Swansea City Council (Llansamlet and Mount Pleasant), Mr H. V. Thomas, Kidwelly Borough Council (Kidwelly) and Mr J. S. Powell (Penmaen).

Messrs J. Briggs, E. N. Lawrence and R. G. Crawford, Meteorological Office, must be acknowledged in promptly supplying the Rhoose wind measurements and computer program for handling them.

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NEW SECRETARY FOR EHA

Mr Kenneth John Tyler has been appointed the new Secretary of the Environmental Health Officers Association, to take over from the retiring Secretary Mr Reginald Johnson on 1 January 1978.

For the last 15 years Kenneth Tyler has been the Assistant Secretary (Technical) of the EHA and is well known as an environmental health expert both within and outside the Association. First working for local government, Ken Tyler held appointments in Dorking and Horley RDC, Epsom and Ewell BC and Reigate BC. For five years before joining the Association headquarters in 1962, he was Deputy Chief Environmental Health Officer of Crawley UDC. He was elected a Fellow of the Association in 1971.

APPEAL FOR PHOTOGRAPHS

The NSCA Library contains an extensive collection of black and white photographs showing domestic and industrial pollution in all its aspects. This photographic hoard has been built up over many years and is in constant use for exhibition and publication purposes. However, 'contrast' photos, pictures showing areas before and after smoke control, or industrial works before and after pollution control devices have been fitted, are scarce and in great demand. If Members have copies of such photographs, or any other suitable pictures, which they would be willing to give to the Library, such donations would be most gratefully received.

NEWS FROM THE DIVISIONS

NORTHERN

The Annual General Meeting of the Northern Division was held at South Tyneside on Friday, 10th June when Councillor L. Poole, BEM, JP, (Middlesbrough BC) was elected as Chairman. The Vice-Chairmen elected were Professor P. C. G. Isaac (Newcastle University) and Mr L. Mair (Individual Member), while Councillor T. W. Yellowley, MBE, was returned unopposed as representative on the Council of the Society.

The meeting heard a talk by Mr J. D. Taylor, Deputy Marketing Director of the Northern Division of the National Coal Board on "The Case for Solid Fuels in Smoke Control". Mr Taylor gave facts and figures to support his argument that there was a place in smoke control for solid smokeless fuel and, indeed, coal with the introduction of the Prince 76 and the new Prince 78. He believed that the value of a flue and chimney in minimising condensation and increasing ventilation had often been overlooked and that many local authorities were unfairly placing the responsibility for enforcing smoke control on coal merchants rather than facing up to prosecuting individual occupiers.

Mr Taylor regretted that there appeared to be virtually no lobby for clean air now it had become more difficult to obtain money for smoke control programmes and it seemed to him that concern for the environment ended at most people's front door. A suggestion that the very high cost of reactive smokeless fuels should be subsidised by a small addition to the price of coal was believed by Mr Taylor to present numerous difficulties, not the least of which was that much solid smokeless fuel was not provided by the NCB. He did, however, promise to submit this suggestion along the line to his superiors.

C. R. Cresswell
Hon. Secretary

EAST MIDLANDS

The Annual General Meeting of the East Midlands Division was held on Thursday, 23 June 1977. Some 67 people were present and were welcomed by the Mayor of Peterborough, Councillor Mrs Jean Barker. The Honorary Secretary presented his report for the year 1976/77 and the financial statement for the year ending 31 December 1976. Mr J. B. Sheard, the Honorary Auditor, reported that he had audited the accounts and found them satisfactory.

Mr K. R. Enderby, the Deputy Chairman, succeeded to the Chair, taking over from Councillor Cashmore, and Councillor Mrs E. M. Tomlinson of the High Peak B.C. was elected Deputy Chairman. Mr E. F. Raven was re-elected as Honorary Secretary, and Mr J. B. Sheard was re-appointed as Honorary Auditor. Mr T. Henry Turner and Mr K. L. Enderby were elected to the Council of the Society for a period of three years.

A competition inviting posters on any aspect of Air Pollution including noise had recently been organised by the Division. District Councils in the Counties of Cambridgeshire, Derbyshire, Leicestershire, Lincolnshire, Northamptonshire and Nottinghamshire were invited to seek entries from schools within their Districts and to decide the winning entry in the Senior, Junior and Infants grouping.

by courtesy of the Derby Evening Telegraph
Jane Hardstaff displays her winning poster

These entries were then submitted for the Divisional winners to be selected. Results were as follows: Jane Anne Hardstaff, Mortimer Wilson School, Alfreton (Amber Valley DC); Vanessa Guiblan, Chaddesden Park Junior School (Derby CC); John Keohane, John T. Rice County Infants School, Mansfield, Notts (Mansfield DC).

Following on from the business Meeting members were given an extremely interesting and entertaining address entitled "Rural Pollution"—High Peak, Derybyshire, by Mr Ian Holmes, Area Environmental Health Officer, High Peak Borough Council. Mr Holmes paper was very well illustrated by excellent slides and the paper was, in fact, an extended version of the one which he had given at the Clean Air Conference in Edinburgh in October 1976. Mr Holmes was warmly thanked for his most interesting paper and the very excellent presentation.

In the afternoon members were addressed by Mr J. G. Thompson, Assistant Secretary, Clean Air Division, Department of the Environment, who is also Secretary of the Clean Air Council. Mr Thompson talked on European Community legislation and air pollution and in the questions and discussion which followed the concern of members about the procedures in Europe and the implications for clean air legislation and control in this country were very much in evidence.

A meeting of the Division was held at Mansfield on Wednesday, 7th September 1977. Mr K. R. Enderby, Chairman, introduced Councillor G. Jelley, Chairman of the Mansfield District Council, who extended a welcome to the delegates, numbering between sixty and seventy in total. Councillor Jelley said the area was steeped in history and stood in the heart of Sherwood Forest. Here James the Sixth of Scotland had become James the First of England. More recently HM the Queen had only six weeks previously performed the official opening of the library in

INTERNATIONAL NEWS

AUSTRALIA

A special unit in the Physical Chemistry Department of La Trobe University, Melbourne, led by Dr Jim Morrison, has made a precise science of tracing the sources and causes of smells. The team have designed and built elaborate equipment to detect and analyse smells and to break down the components of a smell and pin-point what makes it pleasant or unpleasant.

Isolated smell components are analysed by mass spectrometer and the pattern produced is then identified by computer. Meanwhile other 'odour detectives' using their noses, try to track down the source of the smell. Dr Morrison says that while the untrained human nose can detect, but not always identify, about 2,000 smells, a highly trained human nose can detect as many as 10,000 smells. The unit claims many successes and its reputation has spread so widely that odour experts from other countries have visited it to study its detection equipment and methods.

EUROPE

Final Report of the OECD Study on the Long-Range Transport of Atmospheric Pollutants: General conclusions. The programme has demonstrated the possibility of long-range transport of air pollutants over Europe. The greatest concentration of deposits is close to sources of emission; at at the same time, certain places (Southern Scandinavia and Switzerland) have higher total deposition in consequence of high amounts of wet depositions due to greater incidence of precipitation (because of orographic effects) than in neighbouring areas, 2 to 3 times more rain giving twice the acidity.

Measured annual mean SO_2 concentrations range from about 20 $\mu g/m^3$ in rural areas close to major source regions in the FDR, the Netherlands, and the UK, to 2 $\mu g/m^3$ or lower in remote areas of northern and western Europe. Sulphate in precipitation ranges from about 5 mg SO_4/l at sites close to the major source areas, to less than 1 mg SO_4/l in the far north of Scandinavia. Acidity is principally introduced to the precipitations as sulphuric and nitric acid. In west and south-west winds the average concentration of sulphate and acid in precipitation over the Netherlands and Norway, which are due to emissions in the UK, is about 1 mg SO_4/l and 20 μeq/l respectively. It was shown that the underestimate of deposition over the North Sea has led to a systematic overestimate of deposition due to emissions in the UK, by about 20 per cent.

For future research, it would be necessary to have more knowledge of:

—the emissions of countries under study, and of others.
—precipitations, their location and their duration on land and in sea.
—mixing heights, obtained by aircraft measurements, particularly in the cloud layer.
—local emissions close to monitoring stations.

INDIA

Indian Scientists have successfully substituted hydrogen for gasoline in a spark-ignited engine. Researchers at The Institute of Technology in Madras, who achieved this for the first time in India, decided that the problems of engine exhaust pollution could be tackled by investigating hydrogen as a promising alternative fuel to gasoline, diesl or biogas. Mass production of engines utilizing hydrogen as fuel would cut pollution considerably.

Related engine experiments are being conducted by the Indian Government to find simple and inexpensive ways to cut emissions resulting from inefficient diesel performance. Diesels now account for 30 per cent of India's consumption of petrol products, most of it used by road vehicles. Recent studies indicate that major fuel economies and substantial reductions in pollutant emissions can be effected by paying greater attention to operational and maintenance parameters.

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which the meeting was held. Having been designated a 'black area' Mansfield had gone ahead with smoke control and had more than 14,000 premises in operative smoke control areas. Further orders were pending. Smoke and sulphur dioxide figures had decreased from 150 and 99 microgrammes per cubic metre to 60 and 84 microgrammes per cubic metre.

The meeting was informed of the sudden death on 24th August 1977 of Mr Alfred Wade, MBE, former Chief Public Health Inspector of Nottingham, former Secretary of the Division and former chairman of the Division. Members stood in tribute to the memory of Mr Wade and Mr T. Henry Turner spoke in appreciation of Mr Wade's service to the Division.

It was announced that efforts were being made to arrange the next meeting in the area of the Ashfield District Council and that the date would probably be late March 1978.

A business meeting took place, after which the Chairman introduced Mr R. Aldred, Area Ventilation Engineer, National Coal Board, North Nottingham Area to speak upon Coal Mine Ventilation, Dust Suppression and Methane Extraction followed by Mr G. C. Highley, Assistant Director (Administration), National Coal Board, North Nottinghamshire Area who addressed the meeting on 'The Mining Community and the Local Authority'. Following the papers the speakers dealt with questions. Thanks on behalf of the delegates were expressed by the Chairman.

After lunch one party from those attending was taken to the Nationalal Coal Board's East Midlands Regional Laboratory at Mansfield Woodhouse whilst a second party visited the Mansfield Brewery.

E. F. Raven
Hon. Secretary

DIARY OF EVENTS

17 January
Copy date for Spring 1978 issue of 'Clean Air'

26 January (Thursday)
W. Midlands Division meeting, jointly with the Midlands Joint Advisory Council for Clean Air & Noise Control. "Asbestos" by Mr J. K. Verril, Chairman of the Environmental Control Committee of the Asbestos Research Council. **10.30 a.m.** Municipal Buildings, Barrs Road, Cradley Heath.

2 February (Thursday)
a.m. Technical Committee Meeting.
p.m. Parliamentary & Local Government Committee Meeting, London.

8 February (Wednesday)
a.m. Conference & Publicity Committee Meeting.
p.m. General Purposes & Finance Committee Meeting, London.

BOOK REVIEWS

Air Monitoring Survey Design
Kenneth E. Noll and Terry L. Miller. Published by Ann Arbor Science. Distributed by John Wiley & Sons Ltd, Baffins Lane, Chichester. 296 pages. Price £15·00

This is essentially a text book aimed particularly at the American market in response to the demand for air monitoring surveys required for the production of environmental impact statements. It describes in detail how to set up an air monitoring programme in a manner which is systematic and cost effective. Obviously, as the book is designed to help with the preparation of environmental impact statements, it is of value and service to both enforcement agencies and to industrial concerns alike.

The authors approach the subject in a logical manner and first assess the roles of monitoring and modelling. The book then proceeds to discuss mathematical models for predicting air quality in some detail. A chapter is devoted to the general procedures for air monitoring survey design and air pollution regimes are examined on the microscale, mesoscale and macroscale. The importance of site selection for monitoring near line sources, point sources and for background concentrations is then discussed, and there is much useful information about not only where monitoring sites should be established, but also about how many sites are needed. Air sampling and analytical methods for measuring air pollutants are considered in some depth and there are chapters on instrument calibration and on what the authors describe as 'Air Monitoring Hardware'. The latter is a useful survey in itself.

The importance of meteorology is given full weight, and there are chapters on planning meteorological surveys and on meteorological measurements.

Finally, the questions of air quality data summaries and data presentations and air quality data evaluation are analysed in considerable detail.

Each chapter has a reference section and the book contains a somewhat limited but nevertheless helpful glossary. The index, however, is a little scanty and this detracts from the value of the book as a reference work. Notwithstanding, the book serves a useful purpose in that in one volume there is a broad approach to the whole subject describing methods which are right up to date and which are currently being used successfully.

Whether or not environmental impact statements will be required in this country in the same way that they are now required in the US, remains to be seen. But undoubtedly there is a move towards the use of a similar approach in assessing our environmental problems. Industry in particular and others likely to be concerned with such analyses in future will find this book helpful and valuable.

Air Quality in Selected Urban Areas 1973-1974
Published under the joint sponsorship of the United Nations Environment Programme and the World Health Organization, Geneva, World Health Organization, 1976 (WHO Offset Publication No. 30: ISBN 92 4 170030 0). 65 pages. Price: Sw.fr. 15, US $ 6·00

For some years the World Health Organization has been conducting an air quality monitoring project with two main aims: to collaborate with its Member States in establishing and developing air monitoring systems to protect health, and to promote the international exchange of information on levels and trends of air pollution and the use of uniform methods for assessing air quality and improving quality standards. There is a network of participating centres and laboratories in a number of countries, which is being extended for better coverage of worldwide air pollution. Among other things, the monitoring project provides data input for the Global Environmental Monitoring System (GEMS), which in 1976 obtained support from the United Nations Environment Programme (UNEP) for its activities and began to operate on a much broader scale.

The information published in this book was collected at three sampling sites in one major city in each of 14 participating countries, the sites being representative of an industrial area, a commercial area, and a residential area. The data are reported for sulphur dioxide and suspended particulate matter only, but as the scope of the programme expands it is intended to cover additional air pollutants. The data are given in an annex to a brief introductory report in two ways: first as a cumulative frequency distribution table and then as a two-year plot of the monthly means. All the data for a particular city (three stations) and a particular pollutant (sulphur dioxide and particulate matter) are presented on facing pages. In addition, the tables show for each year the number of samples analysed, minimum and maximum concentrations of pollutant, and arithmetic and geometric means with standard deviations. Other annexes list the participating WHO collaborating centres, national centres and other laboratories, show the worldwide distribution of monitoring locations, and summarize the measurement methods employed.

Report of the Avon, Gloucestershire and Somerset Environmental Monitoring Committee on a Survey of Airborne Metals 1977. *209 pages. £4.*

This report is the work of a group of environmental health officers especially concerned with environmental pollution representing fifteen local authorities in the above three counties working in collaboration with the County Analysts.

The Committee's terms of reference were to:
(a) examine environmental monitoring techniques
(b) advise on their statutory duties and responsibilities involving pollution monitoring
(c) co-ordinate monitoring projects
(d) provide a forum for the exchange of technical information

In 1975 the Committee embarked on the above survey with the following objectives:
(a) to produce an overall picture of metallic air pollution in the three counties
(b) to highlight significant metallic air pollution
(c) to examine the data obtained for correlation between the three monitoring methods employed—air filtration, moss bag and Tak and to evaluate the three methods
(d) to examine the effects of meteorological conditions on results

Ten metals were chosen for analysis—lead, zinc, cadmium, copper, iron, chromium, nickel, manganese, vanadium and aluminium. Monitoring was carried out at 150 fixed locations over the three counties.

Ten sites were chosen in each district with air filtration moss bag and Tak monitoring methods being employed at the principal site, and moss bag monitoring at nine secondary sites. More than 20,000 results were obtained in the survey, which lasted for a period of 12 months.

The Report finds that in the absence of appropriate air quality standards it is not possible to assert categorically that all the concentrations found were safe environmentally, but it is reasonable to conclude that there was no gross metallic pollution. However, there were small but significant instances of metal uptake in certain places which were not wholly anticipated.

Copies of the Report are available from the Secretary, Mr H. R. Nowell, M.E.H.A., Bath City Council, Bluecoat House, Sawclose, Bath, BA1 1EX, at a cost of £4 plus p. & p. (75p U.K.).

The European Community's Environment Policy
34 pages

This report is a record of a seminar held in London on 22nd April 1977, sponsored by the European Commission and organised on their behalf by the Planning and Environment Group of the National Council of Social Service. It contains transcripts of the speeches and a summary of the main issues raised in discussion.

The central aim of the seminar was to provoke a broader understanding of the Community's environmental policies and to provide the opportunity for its work to be discussed with a wide range of voluntary bodies concerned with environmental issues in the UK. Papers review the Commission's programme and policies, and the British position in relation to these. Future action in pollution control strategy and nature conservation is outlined.

This is a useful introduction to the thorny problems surrounding Britain's commitments, as a member state, to the environment action programme of the EEC. The report is available, free of charge whilst initial stocks last, from: The National Organisations Division, National Council of Social Service, 266 Bedford Square, London WC1B 3HU.

Environmental Health Report 1976
Environmental Health Officers Association, 1977. 70 pages. 60p.

The Report states that the economic situation has affected the rate of progress towards a cleaner atmosphere. 142 smoke control orders were submitted during the year as compared with 159 in 1975. The effect of a recent circular restricting the payment of grant on the replacement of improved open fires could not yet be assessed.

On contraventions of the dark smoke provisions of the Clean Air Acts, the report points out that cases arise under section 1 of the 1968 Act where it is difficult to prove that the offender was the "occupier" of the land. The term "occupier" is not defined and should be replaced by a phrase referring to the person creating the nuisance. 644 offences (as compared with 418 in 1975) were detected during the year relating to acquiring or selling unauthorised fuel in a smoke control area. This increase, says the report, may be an indication of problems resulting from the rise in cost of solid smokeless fuels.

During the year, four orders for noise abatement zones have been confirmed by the Secretary of State. District councils may introduce these zones which are designated areas in which noise from classified premises may be controlled. The report questions whether it is worthwhile to insulate houses against noise from new or altered highways; reduction in noise levels may not be as dramatic as expected.

CURRENT PUBLICATIONS RECEIVED BY THE NSCA

Journal of the APCA	*Monthly*
ATOM	*Monthly*
Clean Air Australia	*Quarterly*
Clean Air South Africa	*Quarterly*
Council of Europe 'Nature' Newsletter	*Monthly*
Council of Europe 'Naturopa'	*Quarterly*
The Ecologist	*Monthly*
EGIS News	*Monthly*
Electric Vehicles	*Quarterly*
Energy World	*Monthly*
Esso Magazine	*Quarterly*
Euroforum	*Weekly*
Gas Marketing	*Monthly*
Heating and Ventilating Review	*Monthly*
Journal of the Institute of Fuel	*Quarterly*
Modern Medicine	*Monthly*
Municipal Engineering	*Fortnightly*
Municipal Review	*Monthly*
New Scientist	*Weekly*
Pollution Monitor	*Bi-monthly*
Process Engineering	*Monthly*
Recycling and Waste Disposal	*Monthly*
Safety and Rescue	*Monthly*
Solid Fuel	*Monthly*
Solid Wastes	*Monthly*
Staub (German version)	*Monthly*
Town and Country Planning	*Monthly*
UN Development Forum	*Monthly*
Water Space	*Quarterly*
Water and Waste Treatment	*Monthly*

New additions to the NSCA Libary

AERE Harwell. Environmental and Medical Sciences Division. Progress Report January-December 1973. J. E. Johnston and T. V. Sutlar. 79 pages. £1·50 (HMSO)
Ibid. January-December 1974. Ed. J. E. Johnston. 85 pages, £2·00 (HMSO)
Ibid. January-December 1975. Ed. J. E. Johnston. 97 pages. £2·50 (HMSO)
Ibid. January-December 1976. W. M. Hainge. 133 pages. £3·00 (HMSO)
Avon, Gloucester and Somerset Environmental Monitoring Committee on a Survey of Airborne Metals, Report of the. 1977. 209 pages. £4
BSI Yearbook 1977 (Reference only)
The Clever Moron. R. S. Scorer. Routledge and Kegan Paul 1977. 171 pages. £3·95
Concawe Reports:
No. 6/77 Emissions and Effluents from European refineries. Concawe, Sept. 1977. E. C. Cadron and J. P. Klein. 23 pages.
No. 8/77 Measurement of vibration complementary to sound measurement. L. A. Bijl. Concawe, Sept. 1977.
No. 11/77 The relative contribution of industrial and domestic emissions to SO_2 urban pollution. Concawe Special Task Force on Urban Emission/Immission Relationships. Concawe, Sept. 1977. 37 pages.
No. 12/77 Techniques for the analysis of particulate matter in the atmosphere. Concawe Special Task Force on the Study of Air Pollution, Sampling and Survey Techniques. Concawe, Sept. 1977. 120 pages.
Department of the Environment Library Services Annual List of Publications, 1975.
DOE/Dept. of Transport Library Services Annual List of Publications, 1976
DOE HQ Library. Information Series. List of Titles. 4 pages.
Ibid. Sources of Information in Environmental Pollution. 39 pages.
DOE HQ Library. Bibliography Series. List of Titles. 11 pages.
Ibid. Air Pollution. 27 pages.
Ibid. Economics of Pollution. 11 pages.
Ibid. Environmental Pollution Periodicals. 13 pages.
Ibid. Farm Livestock Wastes and Silage Effluent. 19 pages.
Ibid. Freshwater Pollution. 23 pages.
Ibid. Marine and Coastal Pollution. 21 pages.
Ibid. Noise. 42 pages.
Ibid. Pesticides and Antibiotics. 5 pages.
Ibid. Pollution Law and Standards Abroad. 13 pages.
Ibid. Pollution Law in the OECD. 20 pages.
Ibid. Radioactive Pollution. 13 pages.
Ibid. Recycling: The Recovery and Use of Waste Materials. 26 pages.
Ibid. Sewerage and Sewage Disposal. 16 pages.
Ibid. Solid Wastes. 20 pages.
Ibid. (Draft) Trade Wastes.
Ibid. Toxic Metals in the Environment. 19 pages.
Energy Commission Paper No. 1. Working Document on Energy Policy. Pub. for the Energy Commission. 89 pages.
Environmental Health Report, 1976. The Environmental Health Officers Assn. 1977. 70 pages. 60p.
Fuel Consumption, and Smoke and Sulphur Emissions, in the United Kingdom, up to 1976. M-LPM Weatherley. WSL. 1977. 19 pages.
Health and Safety Statistics 1975. Health and Safety Executive. Pub. Govt. Statistical Service. 1977. 58 pages. £1·75 (HMSO).
The OECD Programme on Long Range Transport of Air Pollutants. Summary Report. OECD, Paris 1977. 26 pages.
Pretoria Model Project 1: Data 1976. Vol 4: Gaseous and particulate pollutants. C. W. Louw, R. B. Wells, A. B. Briggs, R. H. Norman, D. van As, C. M. Vleggaar. Council for Scientific and Ind. Res., Air Poll. Res. Gp. Pret. S. Africa June 1977. 63 pages.

CLEAN AIR IN MIDDLESBROUGH

A twenty year programme to introduce total domestic smoke control in Middlesbrough is nearing completion. On 20th October 1977, the Environmental Health Committee of Middlesbrough Borough Council approved the Middlesbrough Nos. 28, 29 and 30 Smoke Control Orders. If these are confirmed by the Department of the Environment it will mean that all the dwellings in the Borough are in Smoke Control Areas.

The programme of smoke control began in 1959 when the then Middlesbrough Corporation Sanitary and Baths Committee approved the first areas to be tackled, and their declared aim was to make the whole Borough "smokeless" by 1979. The householders affected by the new orders about to be introduced have until 1979 to carry out any necessary conversions to their fireplaces.

Improvements in terms of amenity and the health of the community should not be under-rated. The Newport area of the town shows a particularly significant reduction in pollution levels from those which were once identified as the highest winter levels in the country. At that time the levels of pollution were often above those identified by Professor P. J. Lawther of the Medical Research Council as being liable to result in a worsening of patients with pulmonary disease, and even above those identified as being linked with an increase in hospital admissions. It is Middlesbrough Council's proud boast that, having been one of the worst areas in Britain for pollution, the quality of air in the town now complies with the World Health Organisation's most stringent guidelines.

Middlesbrough in 1971—before smoke control covered this area. For contrast, see front cover, which shows the same area in 1976, after smoke control had been completed there

From the start of the control programme successive Councils in Middlesbrough have had to face repeated difficulties and setbacks. The original Smoke Control Programme was largely based on the use of soft coke which was a by-product of the manufacture of town gas. The conversion of fireplaces to burn soft coke rather than coal was relatively easy and inexpensive. Problems first arose when changes in town gas manufacture occurred resulting in less soft coke being available. This trend was continued by the introduction of natural gas, and the result was that fireplaces, in many cases, had to give way to gas fires. Faced with this type of problem, and others of a financial nature, many local authorties slowed down or suspended their Smoke Control Programme. This was not the case in Middlesbrough, despite two reorganisations in local government.

In Middlesbrough there is ample evidence that the general public have actively supported the Councils in their policy. Since 1959 there have been less than 10 objections to Smoke Control Orders. Indeed, in the last four years there have been a number of people who have shown impatience that their house has not been included in an Order.

The drive to reduce domestic smoke pollution has gone hand in hand with a vigorous policy of air pollution control in the industrial and commercial sector using provisions of the Clean Air Acts of 1956 and 1968, and the Council's powers under the Planning Acts. As a result pollution levels in Middlesbrough have been, and still are, falling. The end of Middlesbrough's Smoke Control Programme is the completion of one of the major tasks in the Council's drive to obtain for its residents the best possible air quality.

Letter to the Editor

Dear Sir,

Being very impressed by the value of the current technicological information at the 1977 Clean Air Conference, I was distressed to see the relatively small number of Local Government representatives present.

I am aware of the reason, namely, the reduced availability of funds for attending conferences. It may be thought, by some, that all conferences are an excuse for a measure of enjoyment and a non-productive time. In fact, the N.S.C.A. Conferences and the other educational events planned by the Society are arranged to provide maximum useful information at minimum time and expense. The informal evening discussions on a person to person basis also possible during the Conference are enjoyable as well as informative.

In other words it is clear that public funds are well spent on attendance by all whose work involves clear and acceptable air and water.

During the last Sessions of the 1977 Conference delegates were treated to some most informative talks on the subject of Nuclear Power and the environment by very carefully selected lecturers which proved to be most valuable in getting the right perspective on this new and perplexing subject.

Yours faithfully,

P. Draper, C.Eng.,
Individual Member,
Wareham, Dorset.
September 1977

OBITUARY

Mr A. Wade, M.B.E.

It is with great regret that we have to announce that Mr A. Wade, M.B.E., former Chief Public Health Inspector of Nottingham, died suddenly on Wednesday 24th August 1977.

Mr Wade had been largely responsible for the inauguration of the East Midlands Division and was its Secretary for 19 years. Mr Wade, who was 80 years of age, had held posts in Sheffield and in Washington (near Newcastle) before becoming the Chief Sanitary Inspector of Nottingham in June 1929, a position from which he retired in 1962. His active concern for the cause of clean air will be greatly missed.

Economic Aspects of Air Pollution and its Control

by

R. C. Avery, I.P.F.A.

Group Accountant, Department of Finance, Leeds City Council

Paper delivered to the Yorkshire and Humberside Division of the National Society for Clean Air, Barnsley, 22 February 1977

INTRODUCTION

This paper seeks to examine some of the financial and economic implications of air pollution and measures taken to reduce and control emissions of smoke, gases and particulate matter into the atmosphere.

In the present economic climate, which shows signs of continuing into the next decade, it is even more essential than ever that the economic implications of environmental amenities should be investigated and highlighted. The situation demands all public expenditure should be closely scrutinised and justified on valid economic and financial criteria. It is insufficient to seek to improve the environment by justifying expenditure solely on social considerations.

I believe, however, that this should not cause undue despondency and frustration among those who have been and are dedicated to the cause of achieving a degree of environmental sanity into the second half of the 20th century. One of the aims of this paper is to encourage the "crusaders" to adopt an aggressive attitude to environmental improvement by demonstrating that we as a nation cannot afford not to undertake realistic pollution control measures on economic grounds. The social aspects therefore present themselves as an added bonus.

I propose to consider the implications of air pollution under the following headings.

(i) The Costs of Air Pollution—i.e. the Damage Costs
(ii) Expenditure on Air Pollution Control
(iii) Methods of Control
(iv) Future Policy—some suggestions.

THE COSTS OF AIR POLLUTION

The first general enquiry into the costs of air pollution in Britain was made by the Beaver Committee whose final report in 1954 resulted in The Clean Air Act 1956. The Report of this Committee included an appendix which showed the estimated total cost at that time as some £250M a year in terms of direct costs and loss of efficiency.

A perusal of the Beaver Report amply demonstrates the difficulty and degree of uncertainty in determining such estimates of costs. Even now, some 23 years since this Report, many of the problems of trying to estimate the costs of air pollution still largely persist.

The reasons for this are:

(a) somewhat surprisingly, there is still relatively little quantitative information available on the effects of pollution either in terms of physical damage under controlled conditions, or in terms of economic effects. The relationship between various levels of pollution and the damage it causes is still not generally understood, nor is the relationship of other factors such as sunlight, humidity etc.

(b) the pollution levels which exist in reality are highly variable even over a short distance because of topography, chimney design, combustion temperatures, time, climate etc.

(c) where economic effects are observed, the adjustments by the individuals affected makes interpretation difficult. For example, people living in "black" areas may accept a lower standard of (say) paintwork.

Despite these drawbacks it is still worthwhile attempting to assess damage costs if it is accepted that the order of magnitude, not high precision, is acceptable. Since it is difficult to come to any rational decision as to what efforts should be made to eliminate, reduce, or measure pollutants, or what research priorities should be, without some knowledge of the costs of air pollution and how their alternative actions affect them, it is important to understand the main effects of air pollution and to attempt to quantify the damage costs.

The only comprehensive study of the costs of air pollution in the United Kingdom since the Beaver Report, was undertaken between 1969 and 1972 by the Programme Analysis Unit (A Joint Unit of the Department of Trade and Industry and the Atomic Energy Authority). The Unit published a report in 1972 and much of the following cost information is derived from this publication.

Ideally one would like to measure all damage costs by measuring pollution levels over the whole country and applying statistical techniques. In practice, however, this has not been possible due to lack of data and a simpler approach was adopted by the P.A.U., which nevertheless was found to produce reasonably accurate costings.

Broadly the concept was to envisage a situation where the whole country could be divided simply into either "clean" areas or "polluted" areas, reflecting two different levels of air pollution—high and low. Then, the total national expenditure on the item under study (e.g. laundry, exterior painting etc) may be expressed as—

the unit expenditure (i.e. per person, household etc) in clean areas X number of units, plus the unit expenditure in polluted areas X number of units i.e. E (total cost) $= n_c e_c + n_p e_p$

Assuming that the higher cost in polluted areas is all to do with air pollution this extra cost (marginal cost) to the nation resulting from the presence of areas more polluted than the "clean" areas may be expressed as the Total Cost at two levels of pollution minus the Total Cost at the lower level of pollution.

i.e. C (Extra Cost) $= (n_c e_c + n_p e_p) - n_c + n_p(e_c)$

Quite often information on unit expenditure is not available, but information on another variable which can be expected to change in the same way and which bears a close relation to it may be available (e.g. the frequency of repainting, or cleaning). Similarly the number of units affected in both areas may be unknown,

but it is usually reasonable to assume that the ratio of the number of affected units in "clean" as compared with polluted areas is the same as the ratio of the total number of units in both areas.

On this basis the PAU were able to develop formulae to enable adequate damage costs to be computed.

There are two basic categories of costs of air pollution—

(i) Economic costs which result in physical damage and which can be directly expressed in monetary terms.

(ii) Social costs which are defined as non-monetary costs showing themselves as lower standards or higher degree of suffering.

In its research the PAU sought to identify both economic and social costs, but as already stated in the light of the current economic climate it is the economic costs which must be concentrated on at this time.

The effects of air pollution on various areas has been covered elsewhere and therefore I consider it sufficient to summarise the damage costs identified by the PAU. No attempt has been made to update these costs for inflation, although such figures were produced in 1970, for two reasons:

(i) The difficulty of ascertaining inflation factors for each item under study, and

(ii) the production of such up-dated costs could well be misleading and invalid since conditions may well have changed since 1970.

Therefore, the purpose of presenting these out-of-date figures is to convey an idea of the magnitude of costs and the relative importance in financial terms of the various factors being considered. The areas where resources should be concentrated in terms of research and technological improvement become self evident.

The table below summarises the various extra costs arrived at for the polluted areas (principally in conurbations) over that in other cleaner areas, and presents the estimates given by the Beaver Committee in 1954 for comparison. The PAU figures are significantly lower, where comparison is possible, which could be taken as evidence for positive benefits arising from the implementation of the Clean Air Acts.

Item	PAU Study		Beaver Report
	Economic Costs	Social Costs	
	£M	£M	£M
Painting	—	6·3	30
Laundry and Household Goods (including car cleaning)	0·5	164·0	25
Exterior Cleaning of Buildings	—	1·5	20 (Exterior Cleaning of Buildings and Window and Office Cleaning combined)
Window and Office Cleaning	5·0	—	
Corrosion and Protection of Metal Structures	10·0	—	25
Damage to Textiles, Paper, Leather etc.	33·0	—	50
Agricultural Production	39·0	—	10
Health—Loss of Production —Cost of Treatment —Costs of Premature Death	40·0	140·0	100
Amenities	—	103·0	—
TOTAL COSTS	127·5	414·8	260

Table 1. Estimated marginal annual damage costs

Further, the PAU report made an attempt to assess the total air pollution costs for the U.K. and this is set out in the table below:

Item	PAU Study	
	Economic Costs	Social Costs
	£M	£M
Painting	—	6·3
Laundry etc.	0·5	164·0
Exterior Cleaning of Buildings	—	1·5
Window Cleaning etc.	5·0	—
Corrosion and Protection of Metal Structures	42·0	—
Textiles, Paper etc.	33·0	—
Agricultural Production	195·0	—
Health	130·0	510·0
Amenities	—	103·0
TOTAL COSTS	405·5	784·8

Table 2. Estimated total annual damage costs

The principal pollutants causing damage in the U.K. are still thought to be smoke and sulphur dioxide, or combustion products correlating with these. The Beaver Committee was reluctant to attribute relative costs to sources, but R. S. Scorer published a paper in 1957 seeking to make such an allocation. Generally, the PAU researcher concluded that Scorer's allocation was acceptable and was used as the basis for allocating the economic costs referred to in Table 2.

Of the total economic costs of £405M, some £251M (62%) were estimated to be attributable to domestic sources, 18% to industry, 11% to electricity generation, and 9% to motor vehicles. The size of the domestic contribution is perhaps somewhat surprising, and it is therefore easy to appreciate why some who seek to dramatise air pollution still reject the allocation. Factory fumes and odours are far more eye catching.

However, the PAU, in their projection of damage costs in 1980 (which assumes the virtual completion of the domestic Smoke Control programme) total economic costs are shown to reduce to £252M, of which approximately 34% is related to domestic sources. Industry, electricity generation and motor vehicles are allocated 27%, 19% and 20%, respectively. The fall in damage costs by 1980 of approximately £150M is principally due to the projected fall in domestic emissions, partly offset by an increase in vehicle pollution of nearly 40%.

EXPENDITURE ON AIR POLLUTION CONTROL

Like damage costs, the assessment of expenditure on air pollution control and the costing of individual control processes (e.g. fuel oil desulphurisation) presents considerable difficulty. In the domestic sphere there is no information available as to expenditure by householders who convert to smokeless fuels, electricity, gas, etc. of their own volition, not under Smoke Control Orders, but which obviously contribute to a reduction in the amount of emissions, and which could be included in the total national costs.

With industry it is always a difficulty in deciding how much of the cost of a plant or building is attributable to the control of air pollution, especially when the control features are built into the basic design, e.g. chimneys.

Table 3, below gives details of Central and Local Government's grants to householders in both "Black" and "White" Smoke Control Areas. The table also shows the progress made in "Black" Areas up to 1970, but since then no comparable figures are available. However, up to 30th November 1976 a total of 7,489,000 premises were subject to Smoke Control Orders in all areas in England, which represents 62% of the stated Local Authorities' targets.

Year Ending	Central plus local Government grant (£M)	No. of premises covered in Black Areas (Thousands)	% of total premises in Black Areas converted (%)
To 1.4.65	7·8	2,277	27·8
1.4.66	2·7	335	4·0
1.4.67	3·8	463	7·8
1.4.68	4·8	418	5·4
1.4.69	4·5	353	4·5
1.4.70	4·5	331	4·2
1.4.71	3·8	n/a	n/a
1.4.72	4·1	n/a	n/a
1.4.73	4·5	n/a	n/a
1.4.74	4·2	n/a	n/a
1.4.75	3·2	n/a	n/a
1.4.76	4·0	n/a	n/a
	51·9	4,177 (to 1.4.70)	53·7 (to 1.4.70)

Table 3. Progress of domestic smoke control in England

To the grand total of £51·9M can be added at least a further £22M in respect of the proportion of conversion costs met by householders. On this basis the total cost of Smoke Control Orders in 1975-76 was of the order of £6M.

The PAU Study (1970) estimated that national expenditure of £7M per annum until 1980 would enable all premises in "Black" Areas to be dealt with. It is evident from Table 3 that this level of expenditure has not been achieved but this may well be partly accounted for by an acceleration in the number of householders converting without local authority assistance. As already indicated the percentage of "Black" Area premises currently within Clean Air zones is not known, but it is certain that it is in excess of the 62% quoted for all domestic clean air programmes.

It is interesting to note that the full conversion cost can be recovered, because of the greater efficiency of burning of smokeless and other fuels, in three years, if the same standard of warmth is maintained. In practice the adoption of higher standards means that the recovery of these costs can be achieved in about nine years.

In the industrial sphere pollution control measures are usually geared to the "best practicable means" rather than the maximum level of pollution considered permissible. Even so financial information in this area seems sparse and figures taken from the Chief Alkali Inspector's Annual Report for 1968, detailing control costs for the period 1958-1968, are quoted in the NSCA Year Book for 1976. To give some idea of the order of magnitude of industrial control costs this information is broadly summarised in Table 4.

As already indicated research has been carried out and costs calculated in respect of various control processes such as the desulphurisation of oil and reduction of carbon monoxide, hydrocarbon etc.. emissions from motor vehicles. However, little is known as to how much damage costs would reduce by implementing these controls.

Class of Works	Capital Expenditure	Research & Development	10 years Working Costs	Working Costs in 1968
	£M	£M	£M	£M
Electricity	75·7	0·9	126·7	15·3
Iron & Steel	26·4	1·2	93·4	10·4
Chemical	20·5	1·0	55·5	6·8
Other	27·6	1·9	48·8	6·6
TOTAL COSTS	150·2	5·0	324·4	39·1

Table 4. Cost of Air Pollution Control—Industrial Sources

Notes:

(i) Research and Development costs only include expenditure by research associations, nationalised bodies and scheduled works, and exclude money spent by plant manufacturers.
(ii) Working costs include depreciation, interest, direct operating and maintenance costs, and overheads.

METHODS OF CONTROL

The overriding consideration when making pollution control proposals is that of economics. Economics dictate the extent of pollution control effort. Generally, the present standard of technology is sufficient to control all forms of air pollution and, in most cases, so is the hardware. In practice, control is usually limited to the best practicable means having regard to the economic implications. Control policies which ignore this simple fact are doomed to failure. There are very few examples where pollution control does not increase production costs and impracticable regulations could well price goods out of the market.

Historically, the succession of U.K. governments have relied upon two basic instruments of environmental policy—

(i) Regulatory Instruments, and
(ii) Grants.

The Clean Air Acts 1956 and 1968, the Alkali etc. Works Regulation Act 1906, the Alkali etc. Works Order 1966, the Control of Pollution Act 1974 and the Health and Safety at Work Act 1974 are primarily regulatory instruments designed to reduce pollution levels in accordance with the "best practicable means". In some cases it means the complete absorbtion or elimination of the offensive emission, whilst in others it involves reducing the emission to the lowest practicable limits having regard to cost, local circumstances, height of discharge etc. Great reliance is placed upon education and persuasion although there are various specific emission standards included in the legislation and penalties for non-compliance. Further, there is a contining obligation on the inspectorate and operators to review standards as new techniques for controlling emissions become available.

In the domestic sphere the powers given to local authorities under the Clean Air Acts to create smokeless zones by means of Smoke Control Orders, are supplemented by financial incentives in terms of grants to householders towards conversion costs. Standard scales of maximum permissible costs are provided, and of the total cost of conversion, the central government pays 40%, the local authority 30%, and the householder 30%.

Although they have never been introduced into the U.K. there is, at least theoretically, an alternative method of controlling air pollution—viz. economic instruments. The aim of the economic approach is to seek to remedy the drawbacks of the regulatory approach which is largely negative and subjective in its application, by providing flexibility and motivation, while enabling some objective to be achieved at the least cost to the community.

These ideas, which are assessed in some detail in a report published in 1976 by the Organisation for Economic Co-operation and Development (OECD) entitled "Pollution Charges", are based on the incentive concept. Rather than impose any regulatory constraint, the aim is to proceed in such a way that the polluter will respond to an economic signal. For example, a charge could be levied on polluting emissions or disamenities caused.

The charge has two main features:
(i) it is an incentive
(ii) it is cost effective.
The charge induces the polluter to reduce emissions to a level where the unit rate of charge equals the cost of abating that unit of pollution; beyond this level it is cheaper to pay the charge than to continue the treatment process. The higher the charge the greater the incentive. The optimum rate of the charge will lie at the point where the extra (marginal) cost of treatment intersects the extra (marginal) cost of pollution damage.

There is also the inducement of a better standard of treatment performance by improved technology, shown above as a shallower marginal abatement cost curve.

Further, the rate of charge may be such that it will reduce the emissions of various polluters to a desired average level, and this can be achieved at the least cost to the community. Funds collected by such taxes may be redistributed to polluters whose treatment costs are unduly high.

In practice there are a number of difficulties with this approach. Often the marginal damage costs of various levels of emission are not known; a meaningful basis for the charges is usually difficult to define and rate of charge is not easily fixed objectively. These problems have proved to be greater in the area of air pollution compared with (say) water pollution; and only Norway and The Netherlands have recently taken some tentative steps in this direction.

FUTURE POLICY—SOME SUGGESTIONS

No one can doubt that the overall effect of the regulatory approach linked with Smoke Control Grants in the domestic sector has been overwhelmingly beneficial to society as a whole. At present the criterion of "best practical means" is the most adequate tool we have. If however, in the future the relationship between various levels of pollution and damage both in physical and cost terms can be mastered to a substantial degree, the economic approach could well prove a more acceptable alternative.

However, as smoke pollution is now only approximately 30% of the middle 1950's levels in most "Black Areas" there may well be a strong case for phasing out Clean Air Grants to householders. It is suggested that social factors will induce still more households to convert voluntarily to smokeless fuels, gas, electricity, etc. It may well be desirable to concentrate efforts in certain conurbations where there has been a reluctance by local authorities to introduce a Smoke Control Programme, for despite the Government's powers of compulsion under the Clean Air Act 1968 they have never been exercised.

The Government might do well to reconsider the possibility of introducing legislation to enable householders to receive a grant for conversion as of right, provided that qualifying requirements were met, to overcome the problem of the "sluggish" authority. This system would be similar to "Standard Grants" for housing improvement which gave great impetus to that area when they were introduced in 1959.

The reason for suggesting that in general Clean Air Grants should be phased out arises out of the need to obtain a maximum return for the resources available. It is true that much research is already being undertaken by various research foundations, Universities, Industrial Associations, etc. into the effects of various pollutants and, to a lesser extent, the economic implications. But the need and scope for more resources to be employed in air pollution research is urgent. The efficient use of all resources is now paramount and we can never be certain that present priorities and allocations of resources are correct until some of the gaping holes in our knowledge are stopped up. The aim is effective control not prevention of pollution.

Professor Stairmand in his paper to the NSCA Conference at Scarborough in 1972 entitled "Pollution Control—How Far Can We Go?" comments on this point as follows:

"The basis of pollution control measures should be to limit the effects on amenities rather than to limit the national or global emission of a particular pollutant. It is quite unimportant per se that over 5 million tons of SO_2 are discharged into the atmosphere over Britain each year, but it is of the greatest importance to reduce or eliminate a smaller local emission if it is anywhere in such concentration that it causes a nuisance or a danger. Before we spend large sums of money in seeking an overall reduction of mass emissions, let us see where the problems really lie. In the example quoted above we should investigate fully the fate of the SO_2 in the atmosphere—its dilution, dispersion and neutralisation, and its ultimate destination and concentration. We must then satisfy ourselves that SO_2 in such concentrations will have a significant effect on humans on animals or on vegetation before embarking on some kind of a witch-hunt. It is only by carrying out a proper survey, backed by the most up-to-date resources, and making use of all of the necessary disciplines—technical, medical, biological and zoological—that we will be able to get a true picture of the problem in a particular case so that the control effort can be directed in a proper manner.
"Surely this is the true application of science and economics—not to be deflected by emotional outbursts, but to persist in thorough assessment of the basic problems, then to direct the effort in the most effective way."

The question may be asked who should provide resources for Air Pollution Control—the polluters, the

the local community, society as a whole? I don't know the answer, but perhaps the feeling of the Beaver Committee when recommending that Smoke Control Grants should be financed jointly by all three sectors is on the right lines. To put the whole price of control on industry could well have damaging effects on its competitivity, particularly with foreign industry. On the other hand too much government aid would reduce incentives for technological improvement and a right sense of responsibility towards pollution control.

Finally, for industrial processes for which no economically satisfactory control measures are available careful planning and siting should be pursued to remove such plants from close proximity to large concentrations of people, with its attendant infrastructure.

Much has been accomplished in the field of air pollution control since the War, but nevertheless a tremendous amount of work still needs to be done. As research unfolds new hazards and as new processes produce new problems the challenge appears to increase. Thus the need for objectivity and justification of control measures on economic grounds becomes of even greater importance. This approach may seem to be somewhat cold in the light of social and human considerations, but this method will reap much greater human and social rewards in the long term.

INDUSTRIAL NEWS

Foundry Pollution Control

The recent commissioning of a fabric filter air pollution control installation at Head Wrightson (Steelcast) Ltd's Billingham Foundry makes the plant one of the cleanest internally and externally.

The installation by the London Division of Head Wrightson Process Engineering Ltd, collects fine iron oxide fume from the foundry's new 30 tonne electric-arc steelmaking furnace by capturing it in a specially designed hood which is fixed to and completely covers the furnace-roof and doors. To allow the furnace hood to tilt during the pouring of metal there is an air gap between the hood exit flange and the gas main entrance flange.

Relatively cool air is drawn into the hood by the system's fan, so cooling the hot gas which passes along unlined mild steel gas mains to the fabric filter situated outside the foundry building. The fabric filter consists of four separate rectangular steel compartments in which are hung a total of 1440 five inch diameter by fourteen feet long needled-terylene filter bags.

The dust laden gas enters the bottom of the inside of the filter sleeve where the dust is trapped and the cleaned gas passes through the filter via a common manifold and stack to the atmosphere. These filter sleeves are periodically shaken of dust by the motor driven cam shafts on which they are hung which are energised when one of any four compartments is automatically isolated from the gas stream. The contract included all furnace collection hoods, gas mains, fabric filter, fan, stack and all ancillary equipment.

Reader Enquiry Service No. **7750**

New Tepcon Mobile Twin-Collector Air Cleaner

The new Tepcon Mobile Twin-Collector air cleaner from Actair International Ltd., is a specialised unit, combining flexibility, mobility, and economy, with a high throughput capacity. Designed to clean air at isolated sources of pollution, it is suitable for such applications as welding fumes, oil mist, and grinding dust, particularly where a full-scale workshop system would not be justified.

Employing an electrostatic air cleaning system which removes airborne particles down to a size of 0·03 micron, the Tepcon Mobile Twin-Collector is mounted on castors so that it can be moved easily to be located near pollution sources. Precise positioning is achieved by flexible ducts and hoods, the unit having two collectors so that different pollution sources can be cleaned simultaneously. By using an electrostatic system, cleaned air is returned to the workplace, avoiding the heat losses associated with extraction systems which simply exhaust air outside the building.

Other features of the Tepcon Mobile Twin-Collector unit are a 1·5 kW (2 h.p.) motor with a high performance fan to give a throughput of 1872 m^3/h (1100 cfm), a pull-out drawer for easy removal of heavy particulate matter from the 'transformation box' at the input to the electrostatic part of the air cleaner; an ability to be simply plugged into a convenient power supply; and a distinctive orange colour, for safety purposes, necessary for a unit designed for mobility.

Reader Enquiry Service No. **7751**

Airwick introduces Leasing Arrangements

From October 1st 1977, the Industrial Division of Airwick (UK) Limited is offering to new customers the opportunity of leasing complete odour control installations. This is in addition to the purchase arrangements which currently exist.

Under a leasing Agreement which will normally run for three years, Airwick will install all necessary equipment to dispense NEUTROS odour counteractants at no capital cost to the customer, and thereafter maintain and service the equipment for a nominal rental. A further advantage to the customer is the knowledge that operating costs are fixed throughout the period of the Agreement.

The Manager of Airwick's Industrial Division, Mr E. D. Heath, thinks the service should prove especially suitable for industrial establishments such as chemical and petrochemical plants, foundries, food processing plants, breweries etc. Companies without their own environmental pollution specialists would be able to hand their odour problems over to Airwick for guaranteed control at a guaranteed price.

Reader Enquiry Service No. **7752**

British/Swedish Power Generation Project for U.S. Utility Co.

American Electric Power is proceeding with the next stage of a development project that could result in the greater use of coal for electric power generation while at the same time protecting the environment.

The project focuses on a coal-burning technique known as pressurised fluidised bed combustion (PFBC). AEP is collaborating in this project with two other companies, STAL-LAVAL Turbin AB of Sweden, and Babcock & Wilcox Ltd., Britain's major supplier of utility boilers and world leader in the application of fluidised bed technology.

AEP has decided to conduct combustion tests using Ohio high sulphur coal in the National Coal Board's PFBC pilot plant at Leatherhead, Surrey. Data from that test will be used in the detailed engineering design phase, to determine the final cost estimate for the construction and operation of the PFBC combined cycle demonstration plant (probably to be at the Tidd plant of Ohio power company). Eastern Ohio coal is relatively high in sulphur content.

The plant is to be designed to produce 170,000 kilowatts of electricity. Gases from the fluidised bed combustors at the new facility would operate a 65,000 kW gas turbine to generate electricity, while steam produced in tubes submerged within the bed would be piped to the adjacent Tidd plant to run one of its two 105,000 kW units, generating more electricity.

The six month study, which had paved the way for the ensuing steps in this project, had shown:

—that SO_2 and NO_x emissions from the PFBC would be below Environmental Protection Agency standards and thus assure clean air;

—that it would not be necessary to proceed first with an air heater cycle, but that the project could effectively leapfrog to the combined cycle arrangement;

—that the generating efficiency of the combined cycle would be greater than that of a conventional coal fired plant equipped with flue gas desulphurisation scrubbers.

Reader Enquiry Service No. **7753**

UAS Smokeeter Defugs Rooms

The Smokeeter electronic air cleaner operates on a high efficiency filtering principle. Dirty air is drawn into the unit, electronically treated, and clean healthy air is recirculated back into the once-troublesome area—with no heat losses. Smoke problems within conference centres, restaurants, hotels —in fact wherever people congregate and create a polluted atmosphere— can be eliminated. The Smokeeter is connected to any ordinary electrical circuit and can be shelf-mounted or suspended from the ceiling on rods or chains.

Reader Enquiry Service No. **7754**